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Bailey Meters and Controls for Combustion, Feed Water, Steam Temperature and Condensate at Moores Park Station, City of Lansing, Michigan.

How Bailey makes steam operating duties a pleasure—

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6 Ton Hot Reheat Header

Model test set-up of hot reheat line as reproduced above is approximately 1/10th actual size of the model. Circled area shows position of chrome-moly header in the line.

Size of this hot reheat header can be seen by comparison with men in the picture. It is 21" O.D., fabricated of 2¼% chrome, 1% molybdenum steel.

PRETESTED and PREFABRICATED by Pittsburgh Piping

PART OF A COMPLETE HIGH-PRESSURE, HIGH-TEMPERATURE PIPING SYSTEM

The model shown above exactly duplicates—from an engineering standpoint—a hot reheat line which is part of a high-pressure, high-temperature piping system fabricated by Pittsburgh Piping.

The inset shows the position and relative size of the header in the line, and the main illustration is an actual photograph of this header as fabricated in our shops. The complete system, which includes chrome-moly and stainless steel piping fabrication, is one of scores of installations which we have model-tested, fabricated, and erected.

Use this experience on your next piping job . . . electric generating station, nuclear power installation, chemical processing plant, refinery, mill, or factory. We are specialists with complete facilities, and we assume responsibility for every phase of the work—from blueprint through erection.

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PP-26

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STEAM TURBINE-GENERATORS

By N. K. Halsteen, Project Engineer, Brown Boveri Corp.

BROWN BOVERI

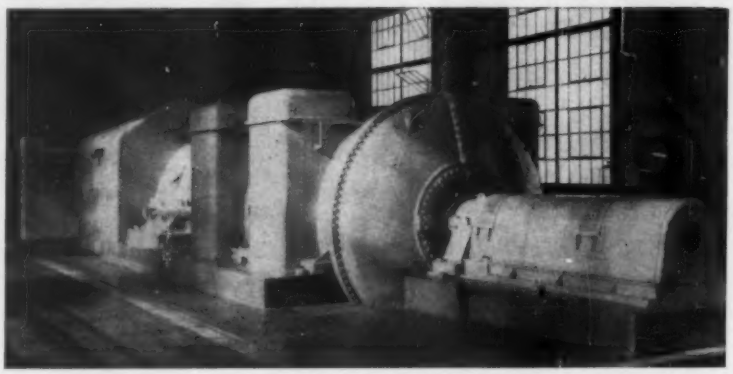
In 1901, Brown Boveri built the first steam turbine installed on the European continent. This turbine was also the world's largest. Since then, the company has made many basic contributions to turbine design and has built more than 5300 steam turbines for generating electric power and for driving blowers and compressors.

Brown Boveri steam turbine-generators include these types and sizes:

Condensing units offer highest efficiency, lowest steam consumption. All ASME Preferred Standard sizes. Single-shaft units to 350 mw. Cross-compound units to 500 mw and up.

Back-pressure units are rated at 500 to 30,000 kw and supply exhaust steam at 20 to 350 psia for low-pressure condensing units or for process.

Extraction-condensing units are rated at 1000 to 100,000 kw. Extraction steam at 7 to 15 psia is used for process and for heating water in municipal heating systems.

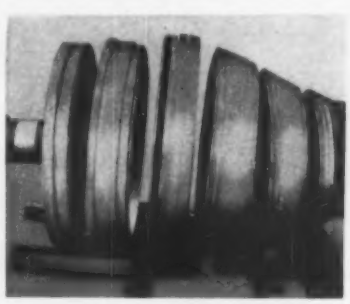


A Brown Boveri 30/33 mw Preferred Standard unit at Greenwood Mills, S. C.

Sectional rotors

Brown Boveri turbine rotors are made of forged sections welded together at the rims. This construction offers advantages over one-piece rotors: The relatively small size of each section ensures a more uniform forging and allows more thorough inspection. Sections with flaws are rejected and replaced virtually eliminating patching often required to salvage large one-piece forgings.

Asymmetries are cancelled out by the random positioning of adjacent sections. The low weight of a hollow, sectional rotor provides fast warm-up and rapid, uniform heat distribution in service. The sectional design eliminates axial stresses. Completed rotors are given ultrasonic tests and stress-relieving heat treatment. *No explosions or other serious failures have ever been experienced with Brown Boveri sectional rotors.*



Sections of a steam turbine rotor before welding. Welding is done automatically by an inert-gas process.

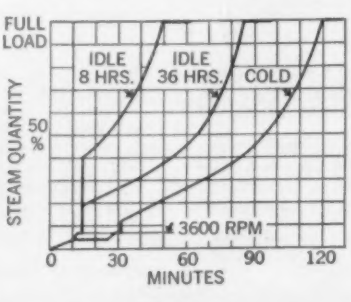
Hydraulic governing system

The Brown Boveri all-hydraulic, governing system uses no mechanical links and thus eliminates joint play or thermal expansion of links which may cause "hunting." Synchronization is quick, simple. On high-temperature reheat units, the governing system is separate from the lubricating oil system and uses a non-combustible fluid.

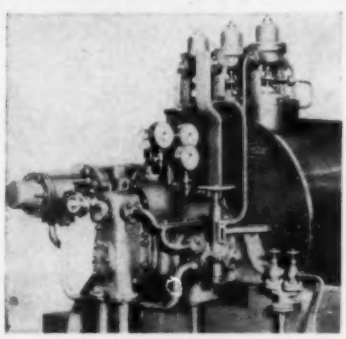
Fast start-up, flexible loading

The low weight of the rotor, lightweight casings and special flange-heating systems reduce temperature differences in the machine to a minimum . . . allowing fast and cold starts, fast changes in load and fast shut-downs without dangerous expansion differentials. Close radial tolerances can be maintained.

These advantages, together with simple synchronizing, are particularly useful where frequent start-ups are required . . . as for peaking.



Starting schedules for a large multi-cylinder reheat turbine . . . illustrating how quickly temperatures in the machine are equalized.



Brown Boveri linkage-free pressure oil governing system. Turbine may also be started and shut down with a single handwheel.

Service

Brown Boveri maintains installation crews and service shops in the U. S. and Canada . . . also working agreements with Todd Shipyard Corp. and National Electric Coil Co. whose shops can rebuild or repair the largest turbines and generators now in use and who have an outstanding record for fast, efficient service.

BROWN BOVERI

Brown Boveri Corp., Dept. PE2, 19 Rector Street, New York 6, N. Y. Agents in 27 U. S. cities.

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PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL ARTS

ENGINEERS' PREVIEW

Robert F. McCaw (left), formerly managing editor of POWER ENGINEERING, takes over as editor from Chester R. Earle, who has retired as the magazine's chief editor

● CHESTER R. EARLE, editor of POWER ENGINEERING, has retired from that post and has been succeeded by Robert F. McCaw, managing editor. Earle will continue to be associated with the magazine as Special Projects Editor.

A native of Massachusetts, Earle was graduated with a B.S. in Mechanical Engineering from Tufts Engineering School of Tufts University. After several years of operating experience in the power field, and also in teaching at Tufts University and at Michigan College of Mines (now Michigan College of Mining and Technology), he joined the editorial staff of POWER ENGINEERING in 1924. He served as associate editor until 1932, became managing editor in 1948, executive editor in 1954, and editor in 1958.

Chester Earle is a Registered Professional Engineer in Illinois and is a member of many engineering and professional organizations including ASME, AIPE, American Society for Engineering Education, International Conference on Large Electric Systems (CIGRE, France). He is also serving on the United States Committee on Large Dams, and on the Water Policy Panel of EJC.

Bob McCaw joined the magazine as associate editor in 1957, after many years of experience in both public utility and industrial power engineering. He has been associated with Interstate Power Co, General Cable Corp, Radio Corporation of America and National Broadcasting Co.

Born in Missouri, McCaw was educated at Missouri University, from which he received a B.S. in Electrical Engineering (Missouri School of Mines), an ROTC commission in the Corps of Engineers, and later an honorary professional degree. He is a member of ASME, AIEE, NSPE, AIPE, Theta Tau engineering fraternity, Incorporated Plant Engineers (England), and International Conference on Large Electric Systems (CIGRE, France).

McCaw has served as managing editor of POWER ENGINEERING since March, 1958.

● RECORD of the U. S. electric utility industry in 1959 looks very good indeed. Summing up, the Edison Electric Institute reports that preliminary figures show that all components of the electric utility industry generated a record 707 billion kwh, an increase of 62 billion kwh, or 9.6 per cent over 1958.

With the addition of railway and industrial generation, but excluding power used or lost within generating stations, total electric production for the nation during the year was 790 billion kwh. This compares with an estimated 1959 production, excluding station use, of 244 billion kwh by Russia, the second-ranking nation.

In generating capability, the electric utility industry reached a new high of 165,000,000 kw by the end of the year. The nation's total electric generating capability, including railway and industrial plants, was 183,000,000 kw.

Construction expenditures by the electric companies in 1959 were $3.5 billion, their third largest expenditure on new plant and equipment. This brought the companies' total investment in plant and equipment to more than $46 billion at year's end.

Late in December a new record was established for weekly output of more than 14.5 billion kwh, exceeding a record week late in August by only 400,000,000 kwh.

Use of electricity in the home continued its rise, reaching a new high of 3550 kwh as the annual average.

Gross revenues of the nation's investor-owned electric companies in 1959 were $9150 million, 8.2 per cent higher than the previous record of $8454 million set in the recession year of 1958. For 1959, the electric companies paid out in wages and salaries $1570 million, an increase of 5 per cent over the 1958 figure of $1494 million. Another important expense item was fuel. In 1959, fuel cost the electric companies $1420 million, a 5.9 per cent increase over 1958.

In 1959, hydro power production in the U. S. totaled 152 billion kwh — three times an estimated 50.7 billion kwh for Russia.

Electric power companies are participating in 16 atomic plants, which will have a combined capacity of about 1,400,000 kw and will require an estimated expenditure by the companies of more than $570,000,000.

By the end of 1960, the total generating capability of the electric industry is expected to be advanced 7.2 per cent over 1959, to reach 176,700,000 kw. Electricity production is expected to be 7.7 per cent higher than the preceding year, with 1960 generation totaling 761 billion kwh.

FOUR-DAY INSTITUTES on hydro and electric plant operation will be offered by the University of Wisconsin's Extension Division on the following dates: Feb 8, 9, 10 and 11; Feb 29, Mar 1, 2 and 3; and Mar 21, 22, 23 and 24.

National Engineers' Week will be observed from Feb 21–27, under the sponsorship of NSPE.

ASCE will hold its national convention in New Orleans, Jung Hotel, Mar 7–11.

American Power Conference meets in Chicago, Hotel Sherman, Mar 29–31.

Argonne National Laboratory

Enrique Baonza Del Prado, of Union Electrica Madrilena, Madrid, Spain, receives certificate from Dr. Norman Hilberry at graduation ceremonies of 9th session of International School of Nuclear Science and Engineering at Argonne National Laboratory. Rollin G. Taecker, school's director, looks on. Forty-three received certificates

STONE & WEBSTER Engineering Corp has announced the election of T. Cortlandt Williams, president since 1955, as chairman of the board. Fred W. Argue, executive vice-president, was elected president to succeed Williams, in a series of top management changes effective January 1.

Born in Vineland, N. J., Williams joined Stone & Webster in 1923 after his graduation from Bucknell University as a mechanical engineer. During the past 26 years he has directed the construction of many different projects including the atomic energy installations at Oak Ridge, Tenn.

Born in Parry Sound, Ontario, Argue joined the firm in 1941 as a power engineer after 20 years of experience in utilities work and engineering education. He served Stone & Webster as engineering manager from 1954 until February, 1959, when he became executive vice-president.

ALL POWER STATIONS, primarily thermal stations, as well as power transmission lines should be manufactured at factories," says Pyotr Neporoshniy, First Deputy Minister of Power Station Construction of the USSR. He says that appropriate standard designs have already been prepared for the transition in the Soviet Union to the factory method of building and assembling power stations.

One standard design for a 2,400,000-kw thermal power station, for instance, is equipped with 300,000-kw turbine generators, and boilers with an hourly capacity of 950 tons of steam. The station is to be built with prefabricated reinforced concrete elements.

Several such stations are to be built in various areas of the USSR during the current seven-year plan (1959–1965). In all, 230 electric power stations are scheduled to be built or modernized during this period. Almost 500,000 men and women are engaged at present at construction sites of electric power stations. Among them are said to be 55,000 engineers and technicians and 35,000 designers.

FREE BOOKLET is available for prospective authors of business and technical books. It's a 50-page manual called "Writing and Publishing Your Technical Book", and is published by F. W. Dodge Corporation, 119 W. 40th St, New York 18, N. Y.

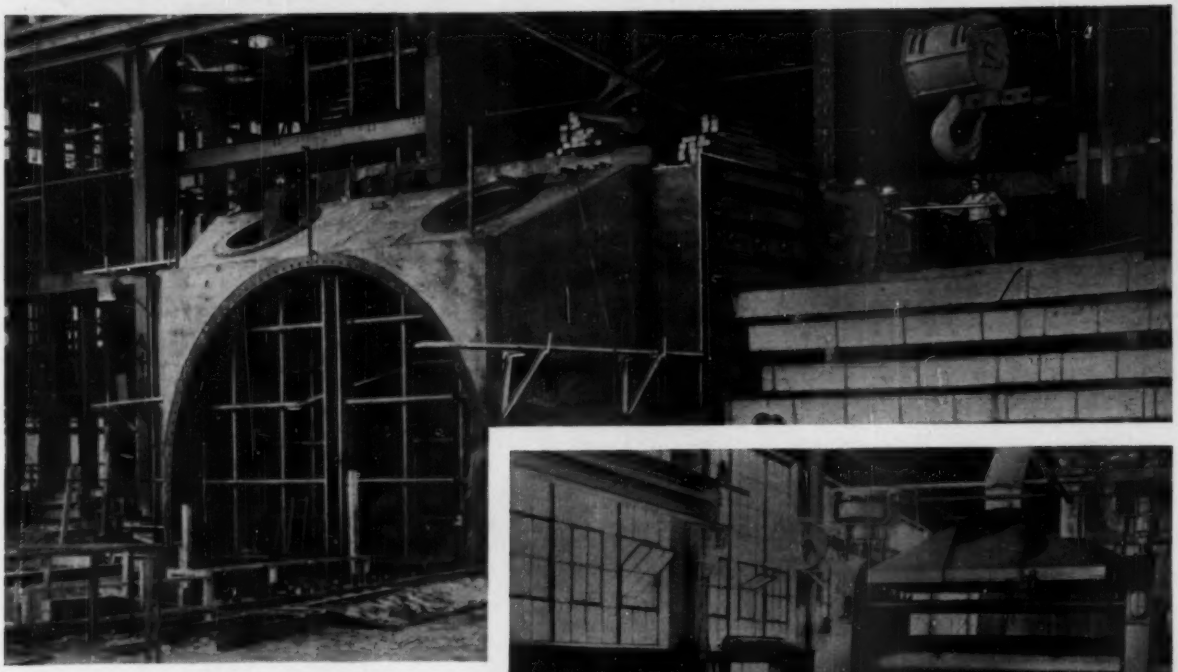
BRIEFLY NOTED: Foxboro Co has been appointed exclusive agent of RCA for its industrial computer products in the process control fields served by Foxboro.

Commonwealth Edison Co has approved a $700,000,000 construction expenditure program for the years 1960 through 1963. Major items in the program are five generating station projects aggregating 1,595,000 kw of new capacity.

National Safety Council has announced release of a series of four training films entitled, Communication for Safety.

Formation of Sentry Equipment Corp has been announced by Raymond E. Paul, general manager of the new firm. It will manufacture and distribute the complete line of Henszey power plant equipment.

7-TON COPPER-ALLOY PLATES FOR LARGE SURFACE CONDENSERS



TOP: View of the new Clinch River Plant of Appalachian Power Co., at Carbo, Va. **ABOVE:** Tubing one of the two huge Allis-Chalmers surface condensers. The 26′ x 15′ openings in the shell use two Anaconda Leaded Muntz Metal-274 plates, each 156″ x 189″ x 1½″ and weighing 13,700 lb. American Brass furnished the eight plates required, as well as the Arsenical Admiralty-439 tubes for the unit above — 19,100 lengths, ⅞″ x .049″ x 30′. **RIGHT:** The big rolling mill at American Brass Company's Detroit Division which produced the plates.

THE unusually large plates required for the tube sheets at Clinch River Plant are standard items of The American Brass Company, which produces plates of copper and a number of copper alloys in rectangular sizes up to 156 inches in width and 15,000 pounds in weight. The maximum standard limits for circles are 160 inches in diameter and 11,000 pounds in weight. Half circles can be produced up to 13,000 pounds in weight.

ROLLED PLATES SUPERIOR. Anaconda rolled plates are commercially flat, accurate in dimensions, and free from surface imperfections and porosity often prevalent in cast plates.

SPECIAL JOBS. Whenever you have a problem involving extremely large plates in standard or special copper alloys, The American Brass Company will gladly assist in its solution. For general information on Anaconda Condenser Tubes and Plates write for Anaconda Publication B-2: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

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Tubes and Plates for Condensers and Heat Exchangers

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WHAT THEY TELL US

▶ **AS WE HAD HOPED,** E. P. Naney's series of three articles on how to design and build electric transmission lines are proving to have value as material for engineering trainees. Published in July, August and September, 1959, these articles are now available in reprint form. Naney reports:

> I have had inquiry from two companies and honorable mention from a number of friends in Iowa, Minnesota and Illinois.

▶ **ANOTHER REPRINT** of POWER ENGINEERING articles which is getting wide circulation for its practical value is the series on valve types. Reprinted as Power Engineers' Valve Manual, this series describes plug, check, blow-off, globe, gate, valve, diaphragm, and butterfly valves. Among recent requests for permission to use this material (gladly granted) is this one from the Philadelphia Building Superintendents' Assn:

> We would like to know if you would give the Association permission to reprint these articles in their 1960 Year Book. The Year Book carries timely articles helpful to building superintendents in their work.

▶ **RECENTLY** the electrical world celebrated the 80th anniversary of Thomas A. Edison's development of the first practical incandescent electric light. On that occasion, Allen S. King, president of the Edison Electric Institute, commented:

> There is significance in how Edison turned what was then a widely ridiculed vision of electrical service into a beneficial reality. He started with an investment of $40,000 of his own money and an initial capitalization of $300,000 of venture money provided by a group of businessmen who had faith in his ability and appreciated his judgment of the potential value of electric service.
>
> Today, the total value of plant and equipment of investor-owned electric companies is about $44,000,000,000. The electric industry in this country was born in a climate of free enterprise and will continue its role of leadership as long as that climate exists.
>
> Edison's original customers paid about 25 cents a kwh for their service. Since that time, the average price per kwh of electricity used in the home has gone down almost continuously, and at the end of 1958 was 2.53 cents — about one-tenth the price at the start of the industry.

▶ **WATER, WATER . . .** but not everywhere, and it continues to be a pressing problem as the nation grows. Water and Sewage Works Mfg Assn sums up the situation very well in these facts and figures:

> From 1940–58 population in the U. S. has increased from 132,000,000 to 175,000,000. Population dependent on public water supply in the same period has risen from 82,000,000 to 125,000,000.
>
> To meet the over-all needs of homes, stores, offices and factories in areas served by water utilities, nearly 20 billion gallons of water per day must be supplied. By 1975 this per capita consumption average will increase to 160 gallons per day.
>
> In producing one gallon of gasoline, 20 gallons of water are used; 40,000 gallons of water are used to make one ton of paper; 110,000 gallons to make one ton of steel. By 1975, U. S. factories alone will need almost as much water as is used today for all purposes combined.
>
> Without adequate facilities for sewage disposal, existing water supplies could become polluted. Up to 95 per cent of the water that is purified and distributed to users must be disposed of as sewage. By 1975 at least 134,000,000 people will be in areas with public sewerage, compared with 100,000,000 today.
>
> In the next 17 years the nation should spend at least $44 billion on water utilities, sewers and sewage treatment plants.

▶ **FOR YEARS** foundrymen have been adding small quantities of silicon to molten iron immediately before casting it. But now it turns out that the improvement resulting from this "inoculation" is not due to the silicon after all. Another element, one they did not realize they were adding, is responsible, according to Dr. Howard L. Womochel, metallurgist at Michigan State University. As Dr. Womochel explains:

> Cast iron can be described as steel imbedded with tiny flakes of graphite that are barely visible to the naked eye. The presence of these flakes gives the iron machinability, castability, wear resistance and many other valuable properties. However, the graphite in iron tends to be contrary and arranges itself in the form of small particles rather than flakes. This reduces the usefulness of cast iron.
>
> Iron also contains small amounts of silicon. Engineers supposed that silicon-containing particles, formed through the iron as it solidified, acted as nuclei on which the graphite flakes built up. We weren't satisfied with this theory. It never seemed reasonable that adding such a small amount of something already present would effect such marked changes.
>
> A combination of calcium and silicon was found to be considerably more effective in producing the desired graphite flakes. Apparently particles of calcium carbide are the nuclei on which grow the flakes of graphite. If such nuclei are absent, the iron "supercools" to a little below its normal freezing point before the graphite appears. Then the tiny particles form, each no more than a tenth as large as a typical flake.

Most effective inoculant, Dr. Womochel reports, is an alloy of about 30 per cent calcium, the rest silicon.

▶ **READER** Richard R. Harris of Provo, Utah, writes:

> Your magazine is, in my opinion, the best in its field. For one thing, it is interesting and useful to the men who run the plants, as well as to top management.

▶ **IMPROVED** metallic rectifiers have made direct current available for control of large magnetic cranes, report A. H. Myles, M. C. Davies and L. J. Srnka of Square D Co, at a recent meeting of AIEE. They explain that . . .

> When a set of bridge-connected metallic rectifiers is used to supply power to a d-c series motor and its crane hoist control, the d-c output voltage will be about 1.3 times the line-to-line a-c three-phase input voltage. This means that for a 230-v a-c supply, a 230-v d-c series motor will be energized from 300 volts, with a consequent increase in speed and horsepower rating.

Other advantages are seen as faster hoisting and lowering speeds, greater stability in lowering heavy loads, better hoisting characteristics and faster acceleration, four collectors in place of 10 or more in the usual a-c hoist control, and better voltage regulation.

Flexonics joins a famous family

. . . to bring you better products and services

Flexonics Corporation's new affiliation with Calumet & Hecla, Inc., marks another important forward step.

Over its fifty-year history, Flexonics has become a major factor in the precision forming of thin metals—in the manufacture of metal hose, metallic bellows, expansion joints, hydraulic hose assemblies, automotive parts, aircraft and missile ducting systems—virtually everything for combined motion and fluid flow.

Calumet & Hecla now brings its broad industrial base to Flexonics technology. To industry, this means that new research and development facilities, new production capabilities, will soon be bringing you even better Flexonics products, an even wider range of Flexonics services.

The entire Flexonics organization is looking forward to serving you better . . . in more ways.

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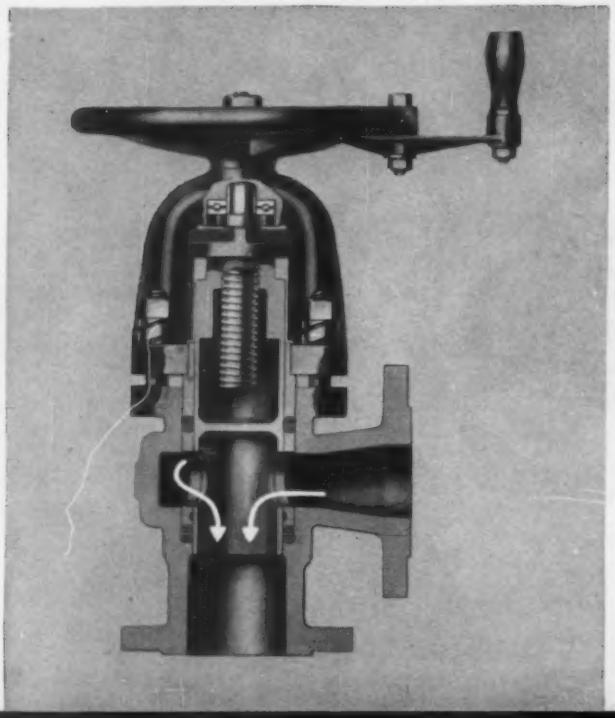

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YARWAY HARD-SEAT

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USED IN OVER 15,000 BOILER PLANTS

serve every boiler blow-down need

■ Whatever your *pressure* requirement, whatever your *piping* requirement—there's a Yarway Blow-Off Valve to exactly meet your needs.

Popular Yarway *seatless* design keeps blow-down lines drop-tight in low and medium pressure ranges. Sturdy Yarway *stellite seat and disc* design protects higher pressures.

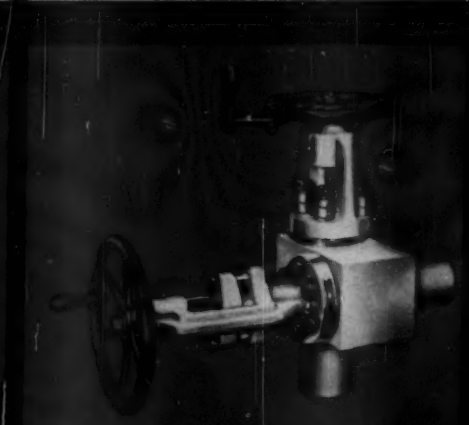
All Yarway Blow-Off Valves are strong, rugged valves, built to withstand the punishment of regular or emergency blowing-down under full boiler pressure, and are available in metals that stand up under acid washing of boilers.

Write for new Yarway Blow-Off Valve Bulletins—B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).

• Yarway Type B Seatless Blow-Off Valve, iron body for boiler pressures to 200 psi, steel bodies, for pressures to 400 psi. Angle valve shown, straightway available. Flanged connections. See Bulletin B-426.

• Yarway Type B Seatless Tandem Blow-Off Valve combining two angle valves. Other combinations available. Iron bodies for boiler pressures to 200 psi, steel bodies for pressures to 400 psi. See Bulletin B-426.

• Yarway Type C Seatless Tandem Blow-Off Valve combining angle and straightway valves. Other combinations available. Flanged or welding connections available. For boiler pressures to 600 psi. NOTE: When used in tandem with a Yarway Hard-Seat Valve, Type C Seatless may be used to 1500 psi. See Bulletin B-434.



LET YARWAY HELP SOLVE YOUR BOILER BLOW-DOWN PROBLEMS!

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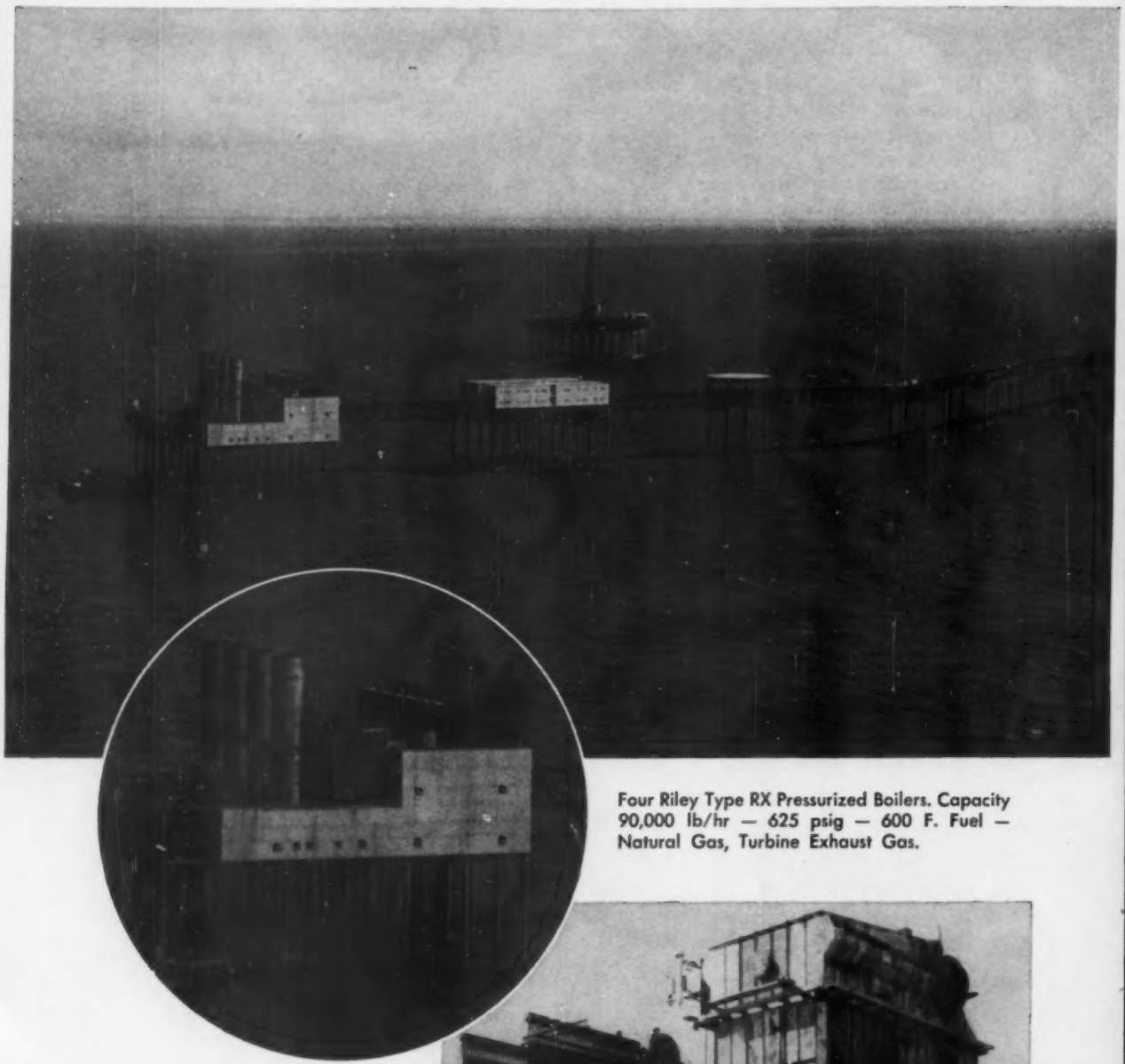
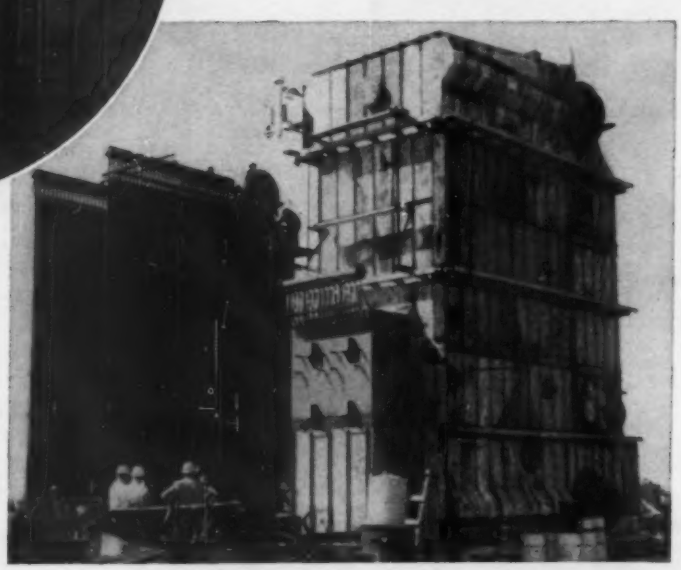
YARWAY

blow-off valves

FOUR RILEY Boilers Help



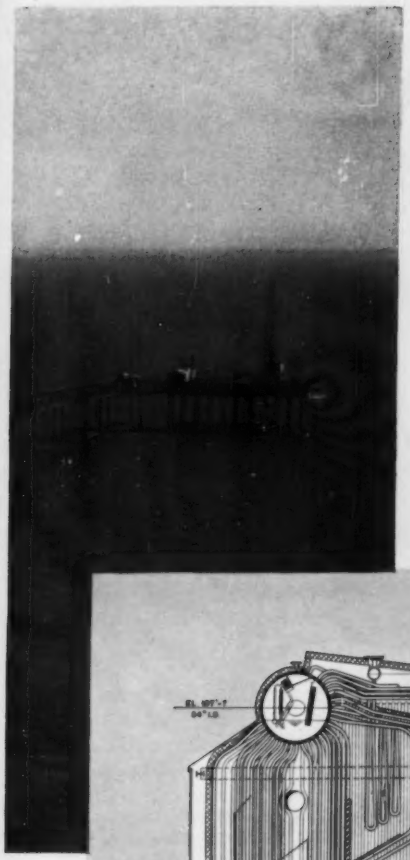
Four Riley Type RX Pressurized Boilers. Capacity 90,000 lb/hr — 625 psig — 600 F. Fuel — Natural Gas, Turbine Exhaust Gas.



Low excess air, refractory elimination, uniform heat distribution and absorption are the desirable characteristics of the Riley Intertube Gas Burners.
Prefabricated assembly of boilers assists in delivery and speeds construction.

A careful survey of your plant by a qualified consulting engineer could show ways of making substantial savings in power costs.

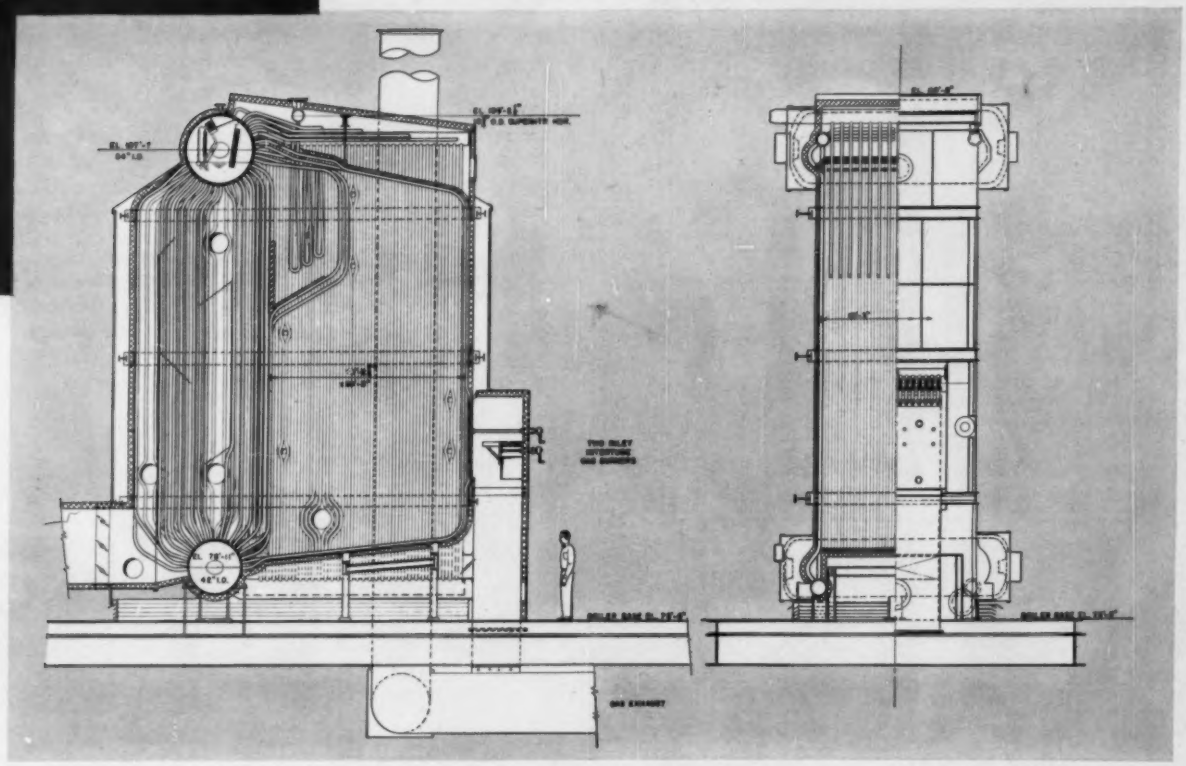
Mine Sulphur Seven Miles At Sea



Freeport Sulphur Company has installed four 90,000 lb/hr Riley type RX Pressurized Boilers on the World's largest man-made structural steel island in 50 feet of water seven miles out in the Gulf of Mexico (off Grand Isle.) These boilers will supply steam for electrical generation and steam for the Frasch Process of mining ancient brimstone deep below the Gulf's floor from a platform 75 feet above the water line.

Boiler settings must be strong enough to withstand hurricane force winds, vibration free, and light in weight.

Here is another example of how Riley designs and builds boilers to meet unusual engineering specifications. Let your Riley sales representative provide you with up-to-date information about Riley boilers and fuel burning products.



You'll Find A Riley Representative In Each Of These Principle Cities:

Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, St. Paul, Syracuse, Boston.

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STEAM GENERATING & FUEL BURNING EQUIPMENT

RILEY STOKER CORPORATION, WORCESTER, MASS.

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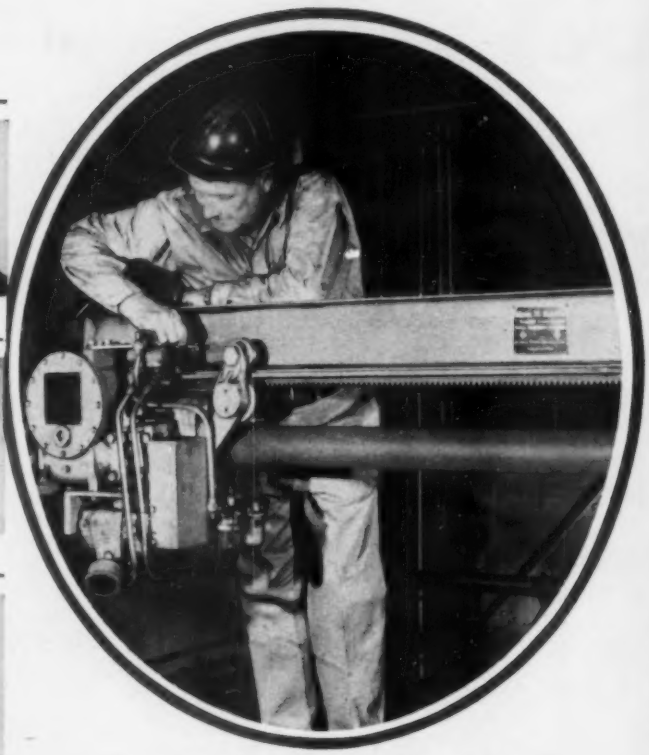

Diamond Service Specialist making an adjustment on a Model IK Long Retracting Blower to assure maximum cleaning efficiency. Diamond Service is effective preventive maintenance.

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A unique field service dedicated to giving you

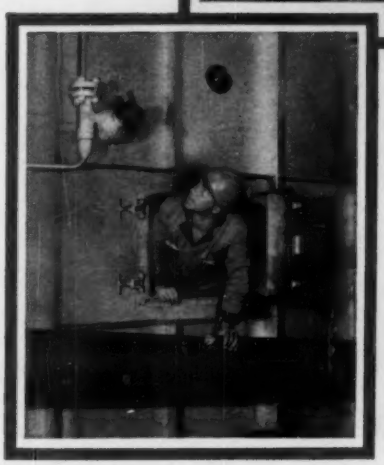
Better Boiler Cleaning At Lower Cost

The principal duty of these 31 full time, factory trained field service specialists is to insure that Diamond Blowers operate correctly to give you the best boiler cleaning possible and at minimum cost. They are cleaning experts who inspect and adjust Diamond Blowers in stationary (and marine) water tube boilers. This inspection service is rendered regularly . . . unsolicited and without charge.

There is nothing else quite like it in the power industry, and it saves the user of Diamond Blowers money two ways: First, these men often are able to detect potential trouble before it becomes serious or costly . . . preventive maintenance that keeps repair costs down. Second, by seeing that blowers are in good repair and adjustment . . . instructing operators in correct operation and care . . . and by recommending the most efficient and economical blowing schedules, they assure cleaner boilers at lower cost. Boiler efficiency is maintained . . . blowing costs kept down.

This is one of many important plus values you get with Diamond Blowers and Blower Systems.

Diamond Service Specialist showing operator how his flue gas temperature drops when he uses his blowers correctly and regularly.



Diamond Service Specialist makes internal inspection to check cleaning effectiveness of the blowers.

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LANCASTER, OHIO

Diamond Specialty Limited • Windsor, Ontario

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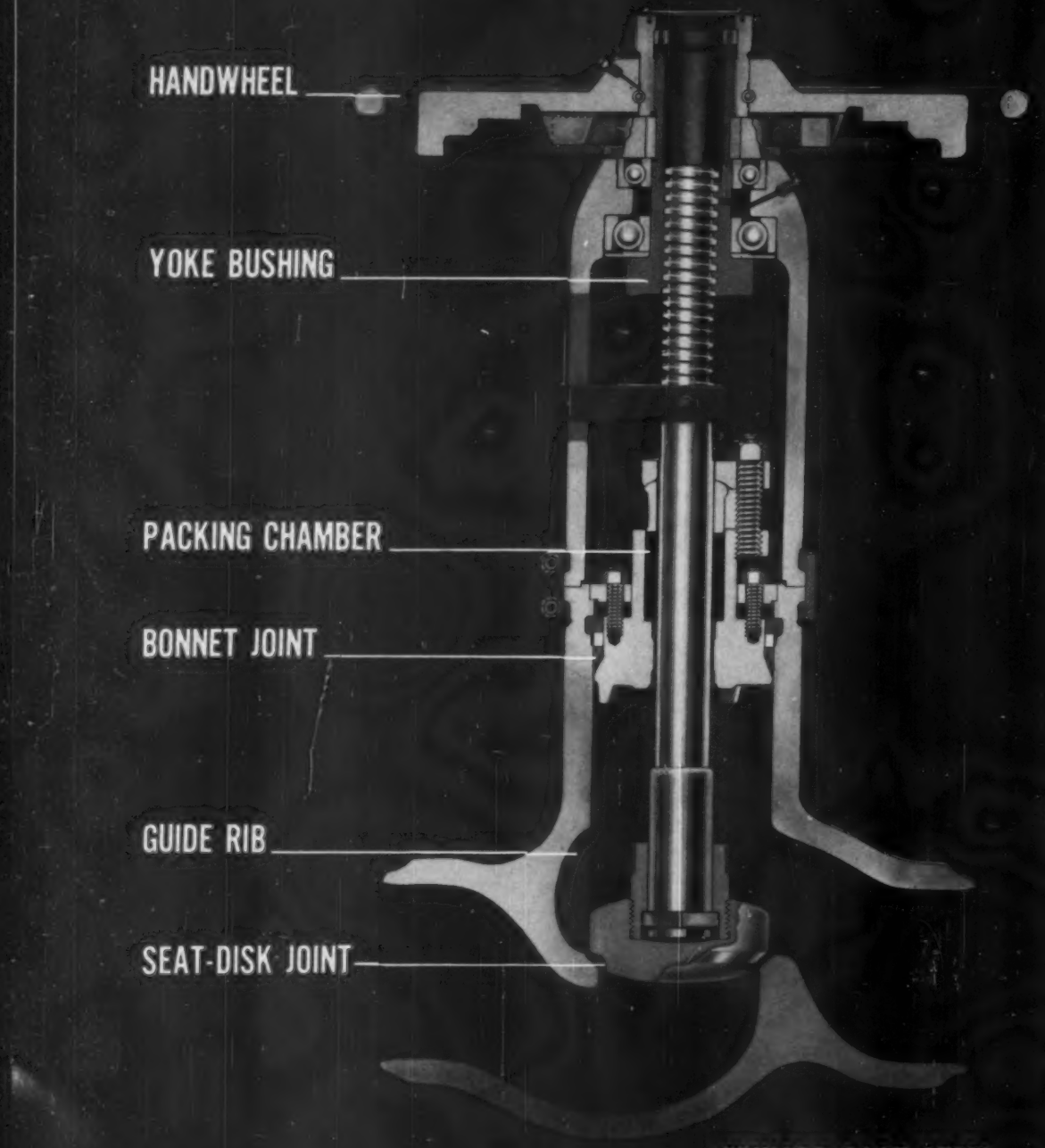
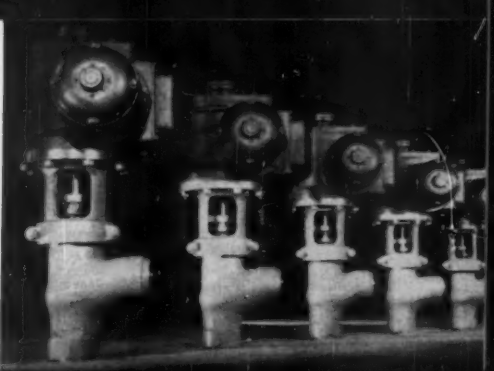


EDWARD CAST STEEL
GLOBE VALVE FIG. 4016Y

IMPACTOGEAR® OPERATED VALVE ←

→ MOTOR OPERATED VALVES



What's New from Edward Valves

New Products . . . Solutions to Problems . . . Information on Steel Valves from Edward, Long-Time Pioneer in the Field!

HOW TO SELECT CAST STEEL VALVES

Valves for today's high-pressure processes require economy, dependability and safety in operation. The material on these pages is designed to help acquaint you with a few basic principles and features you should consider when selecting cast steel valves 2½ inches and larger.

VALVE FEATURES FOR LONGER LIFE, EASIER OPERATION

Valve Handwheel should be large enough to operate valve easily. On smaller valve sizes, a knobbed handwheel design permits tighter grip. But for larger, high-pressure valves, impact-type handwheels will increase closing force, insure tighter closure (see large illustration opposite page). Quick closing can be obtained with impact-type handwheels geared for closing with the aid of portable air or electric wrenches (bottom-left, opposite page). Or, where central or automatic control is desired, consider fixed motor operation (bottom-right, opposite page).

Yoke Bushing on larger valves in higher pressure classes should be equipped with double ball-bearing construction for reduced operating torque and effective transmission of closing load (large illustration on opposite page shows this design). Material is important, too. On smaller valves, bushings of bronze will help prevent stem seizing or galling. Look for ample thread engagement between bushing and yoke and between bushing and stem.

Packing Chamber should be large enough to insure long packing life. Valve packing must allow the stem to move within the bonnet but must not allow any fluid leaks between them. Well made packing, formed specifically for the packing chamber and correctly compounded for your pressure-temperature service conditions, has much to do with satisfactory valve performance. Valves with a positive backseat for re-packing while under pressure offer additional operating advantages.

Bonnet Joint of bolted construction (see Fig. 618 this page) is easiest to work with on medium or small size valves. But for lasting bonnet joint tightness, in high-temperature services (and for reduced size and weight), pressure-seal bonnet joint design is best—no flanges or bolting to periodically restress (see large illustration opposite page). Not all pressure-seal designs are alike, however. Avoid gaskets with small sealing surfaces and sharp edges that can be easily damaged and large threaded gasket loading mechanisms that are hard to disassemble and give unknown gasket compression.

Disk Guiding that properly centers the disk into the seat for positive shut-off regardless of position is important. Valve bodies with integrally cast guide ribs supporting disk throughout travel are best. Avoid designs which attempt to guide by installing spider in seat opening.

Seat-Disk Joint—An integral hard-faced seat is generally regarded as superior to screwed seat construction because it eliminates body-seat leakage and retains hardness under temperature. A hard-faced disk or disk of special alloy is desirable in high temperature services; but 13 per cent chromium stainless steel is an excellent all purpose material below 750° F.

Body Design with streamlined flow passage areas (opposite page) reduces wear-producing turbulence, decreases pressure drop and delivers maximum flow. Valves with streamlined body contours will often permit the use of smaller pipe and valve sizes. Angle valves (see Fig. 7517Y, upper right) have even less pressure drop.

For more detailed information, contact your Edward Representative, or write Edward Valves, Inc., 1202 West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 360 Notre Dame Street, W., Montreal 1, Quebec.

Edward Valves builds a complete line of cast steel stop, check, non-return, stop-check and gate valves for pressures to 10,000 lbs. available with flanged or welding ends. Below are illustrated a few of the major valve designs from this complete line.

Fig. 7517Y
Angle stop valve, 1500 lb at 850 F. (3600 lb WOG), with integral Stellite seat, Stellited disk, pressure-seal bonnet, welding ends. 2½" to 14".

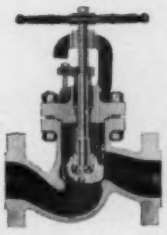


Fig. 618
Globe stop valve, 600 lb at 850 F. (1440 lb WOG), bolted bonnet, flanged ends, integral Stellite seat, Stellited disk. Sizes 2½" to 6".

Fig. 607Y
Angle non-return valve, 600 lb at 850 F. (1400 lb WOG), with pressure-seal bonnet, integral Stellite seat, Stellited disk-piston, welding ends, sizes 8" to 14".

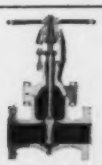


Fig. 611—Gate valve, 600 lb at 850 F. (1440 lb WOG), with hard-surfaced seats and wedge, ball bearing yoke, flanged ends. Sizes 2½" to 12".

Fig. 4094Y—Horizontal check valve, 900 lb at 850 F. (2160 lb WOG), with integral Stellite seat, Stellited disk-piston, pressure-seal cover, welding ends. Sizes 2½" to 14".

Fig. 7514—Flite-Flow globe stop valve, 1500 lb at 850 F. (3600 lb WOG) or 2500 lb at 850 F. (6000 lb WOG), with extremely low pressure drop and other premium features. Sizes 10" to 18".

EDWARD STEEL VALVES
another fine product by
ROCKWELL

Catalog 14 contains full data on the complete Edward line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressures up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets, with screwed, welding or flanged ends.

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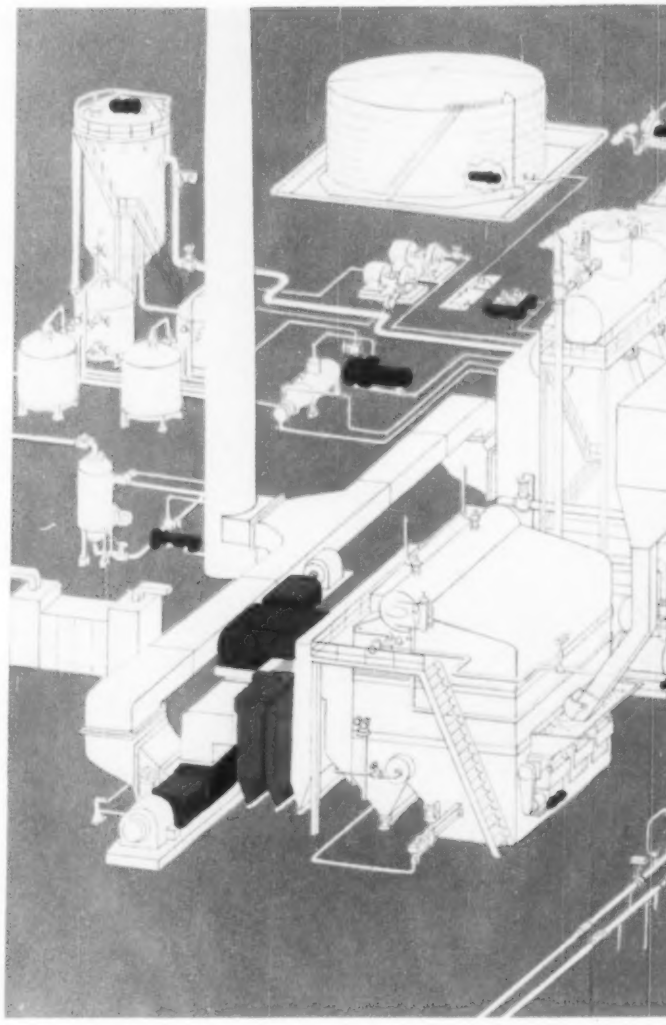
American-Standard Industrial Division **POWER-LIFT IN ACTION**

1959

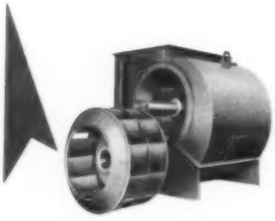
Early in 1959 three American-Standard divisions—American Blower, Ross Heat Exchanger, and Kewanee Boiler—were combined into a single organization under a new name: American-Standard Industrial Division. The year 1959 was spent fruitfully—consolidating product lines, accelerating new product development, gearing up to meet the stepped-up requirements of the fast-paced, highly specialized power industry.

1960

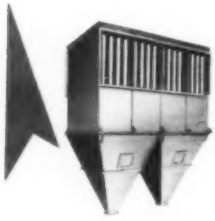
Today, we're confident that you'll find new benefits in specifying products from American-Standard Industrial Division . . . products that now encompass the major fields of heat transfer, mechanical draft, boiler feed pump and fan control, fly ash and dust control, heating, ventilating, and air conditioning. The illustration at right shows where many of these products may be applied in a modern steam plant. Each is designed, engineered, and manufactured to help you produce power efficiently and economically. Each is backed by an honestly won reputation for reliability on the job.



Here's where some of Am



Mechanical Draft Fans



Dust and Fly Ash Collectors

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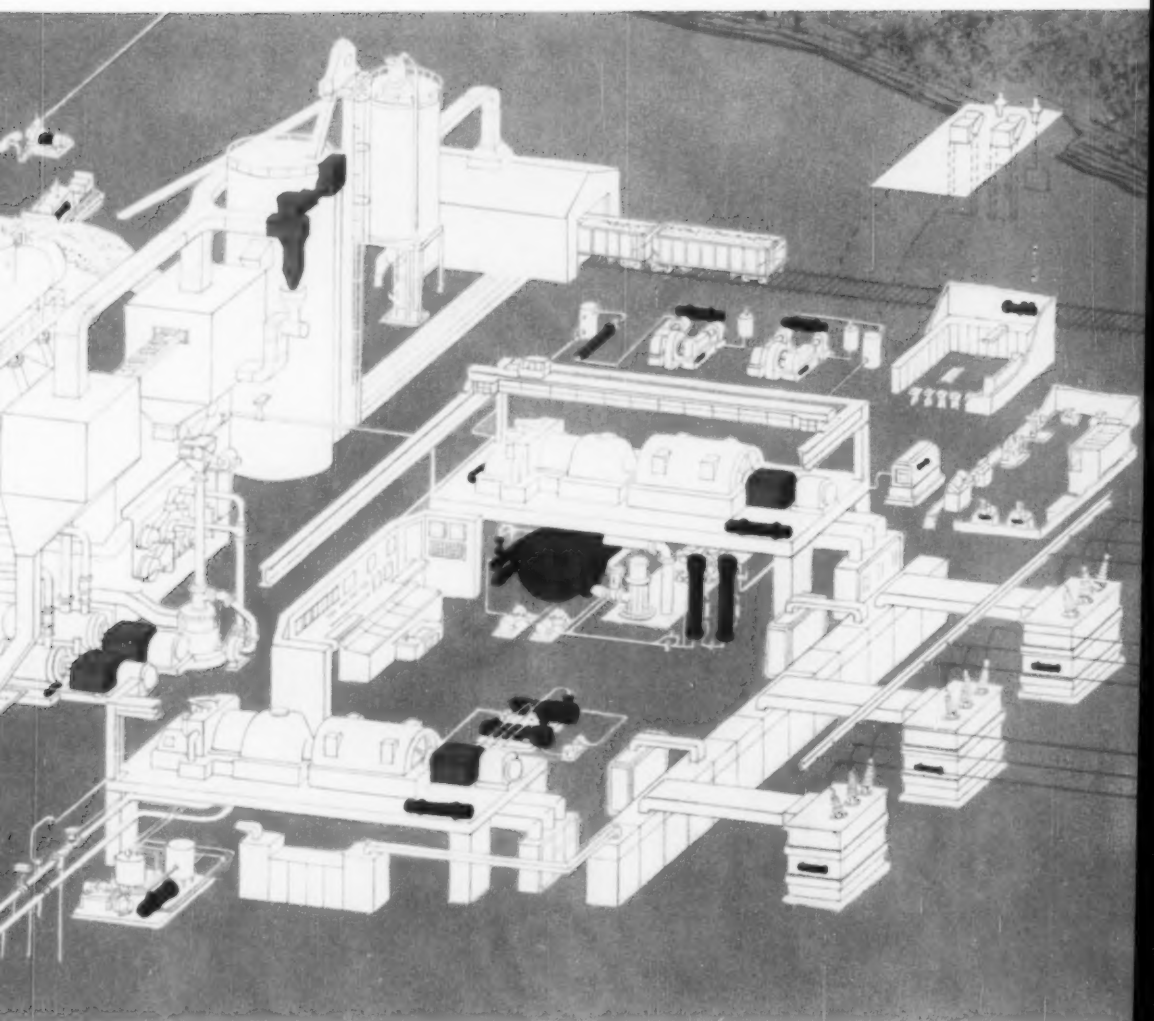
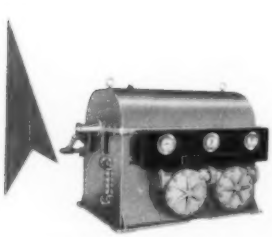
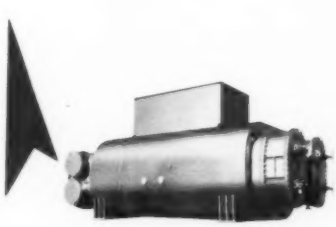


of American-Standard Industrial Division products serve in a modern power plant.



Gyrol® Fluid Drives for fan and feed pump control



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Talk over your requirements with an American-Standard* Industrial Division product specialist. You'll find him well prepared and experienced—frequently able to base equipment recommendations upon precedents of proved success. And, in many instances, our comprehensive standardization paves the way to savings in time and cost. Offices in all principal cities. AMERICAN-STANDARD INDUSTRIAL DIVISION, DETROIT 32, MICHIGAN. IN CANADA: AMERICAN-STANDARD PRODUCTS (CANADA) LIMITED, TORONTO, ONTARIO. EXPORT DIVISION, AMERICAN-STANDARD, NEW YORK CITY.

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service the largest of omorrow's steam tur- bundle entrance ral steam transporta- oisture impingement d tube life; expansion effective de-aeration ther features created ears of surface con- opment and research.

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Design incorporates unique new High Pressure closure. Maintenance is simplified with only four major parts. Exceptionally high safety factor built into all units—more than double ASME Code requirements. Temperature stresses from start-ups or load changes virtually non-existent.

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Provides stepless adjustable speed control for fans and boiler feed pumps. Performance, power savings, and reliability proved in the field. Units for motor driven boiler feed pumps or for "on-the-shaft" duty on main turbine generator. Drives are available for fan and pump duties for all boiler sizes.

DUST AND FLY ASH COLLECTORS

Type "D" Dust Collector: mechanical "cyclone-type" collector. Series 342 Dust Collector: uses "cyclone" principle, with individual tubes which permit flexibility in design to fit plant layout. Series 361 Dust Collector: combines primary and secondary systems for high efficiency fly ash recovery.

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INDUSTRIAL DIVISION

AMERICAN BLOWER PRODUCTS • ROSS PRODUCTS • KEWANEE PRODUCTS

Replace Complete Trim Without Removing Valve From Line!

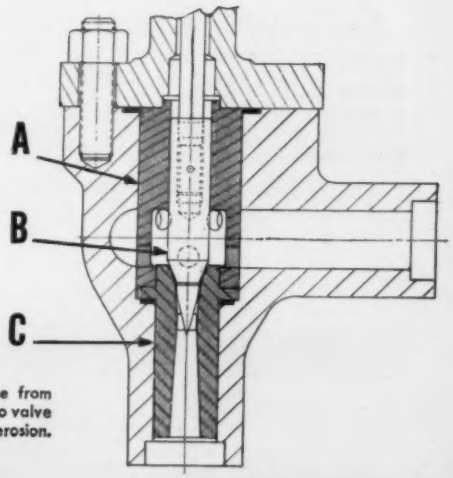
Rockwell-built Republic V-10 valves with Quick-change Trim save many hours of downtime on severe energy conversion applications with pressure drops up to 3500 lbs.

The Republic V-10 angle valve for high-pressure liquid or steam regulating services offers unique valve maintenance advantages because of its Quick-change Trim construction.

Quick-change Trim in the V-10 valve makes it possible for you to replace the valve seat, inner valve and guide in little more time than is required to dismantle and reassemble a bolted joint. No time is required for lapping the seating surfaces of the valve, since this is done in advance. *And you can make this quick trim change in minutes without removing valve from the line.* The savings to you are considerable in downtime and maintenance expense.

Republic V-10 Valves are available with either welded seat or replaceable seat, in addition to the Quick-change Trim design, with bolted or pressure seal bonnets. V-10 valve contours are designed to produce not only the desired regulating characteristics, but also to reduce erosion damage and noise as well. Precise manufacture and long-life materials make Republic regulating valves perform better, last longer, with less maintenance. For additional information, contact your nearest Republic Representative, or write to Republic Flow Meters Company, 2240 Diversey Parkway, Chicago 47, Illinois. In Canada: Republic Flow Meters Canada, Ltd., Toronto. Subsidiary of Rockwell Manufacturing Company.

Rockwell-Republic V-10 regulating valve with Type J-1 positioner is designed for rugged high-pressure liquid or steam service.



Quick-change Trim feature makes it possible to replace the seat guide (A), inner valve (B), and seat (C), without removing valve from the line. Seat extends to valve outlet to prevent body erosion.

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more fine products by
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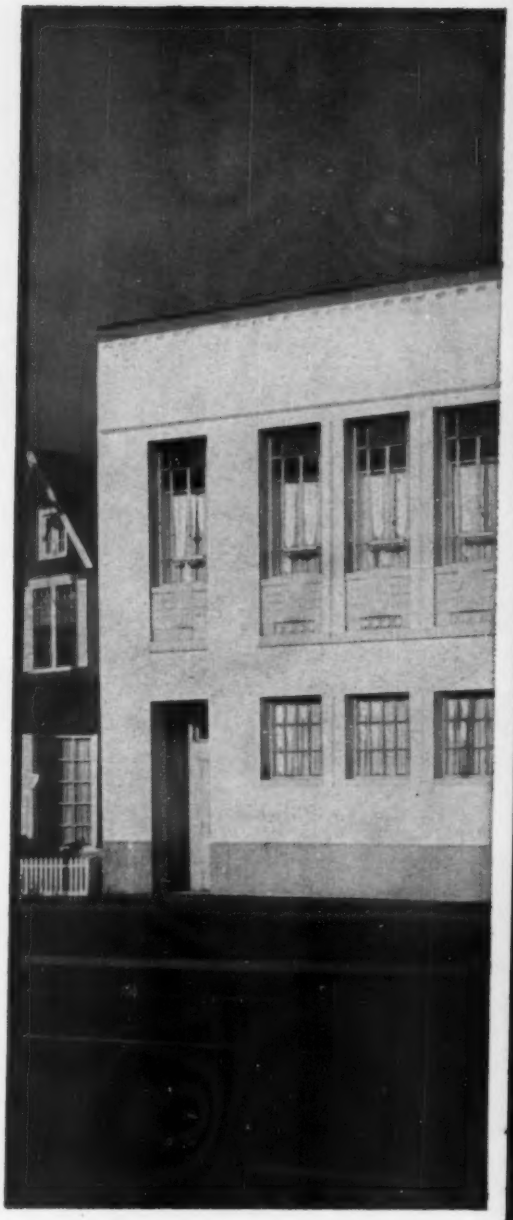
Persons in the know
are specifying fuses

HATFIELD Electric Co.,

a leading electrical contractor,
installs—

FUSETRON dual-element Fuses

in its new office building



This Hatfield Electric Co. installation underscores the need for . . .

LIFE-TIME DEPENDABILITY AND HIGH INTERRUPTING CAPACITY IN A MODERN PROTECTIVE DEVICE — *You Get Both With* FUSETRON Fuses . . .

Mr. Brown, Vice-President tells why . . .

"For our own buildings and our recommendations to our industrial and commercial customers, we feel that FUSETRON fuses are the most reliable means of overcurrent protection that has been made available to us.

"We require protective devices for industrial and commercial application that not only provide adequate short-circuit protection but also protect against needless blows. In dead-front panel equipment it is especially desirable that they operate cool and efficiently. Of course FUSETRON fuses provide this.

"The additional protection features of these devices are of continual interest to our customers, and we feel their use is to our mutual benefit.

"As a matter of further interest, we are remotely mounting the fluorescent ballasts throughout our own offices and adding your fuse blocks with indicating FUSETRON fuses for better protection and lower maintenance."

William L. Brown.
V. P. HATFIELD ELECTRIC CO.
CLEVELAND, OHIO

THERE IS A BUSS OR FUSETRON FUSE FOR EVERY ELECTRICAL NEED

SAFE PROTECTION THROUGH THE YEARS . . .
without maintenance or recalibration costs.

FUSETRON fuses remain safe and accurate because, unlike mechanically operated devices, they have no hinges, pivots, latches or contacts to stick or get out of order.

FUSETRON fuses are *calibrated at the factory by engineers.* Once properly installed, they require no maintenance — no periodic inspection and accompanying down-time.

PROTECT AGAINST HIGH FAULT CURRENTS

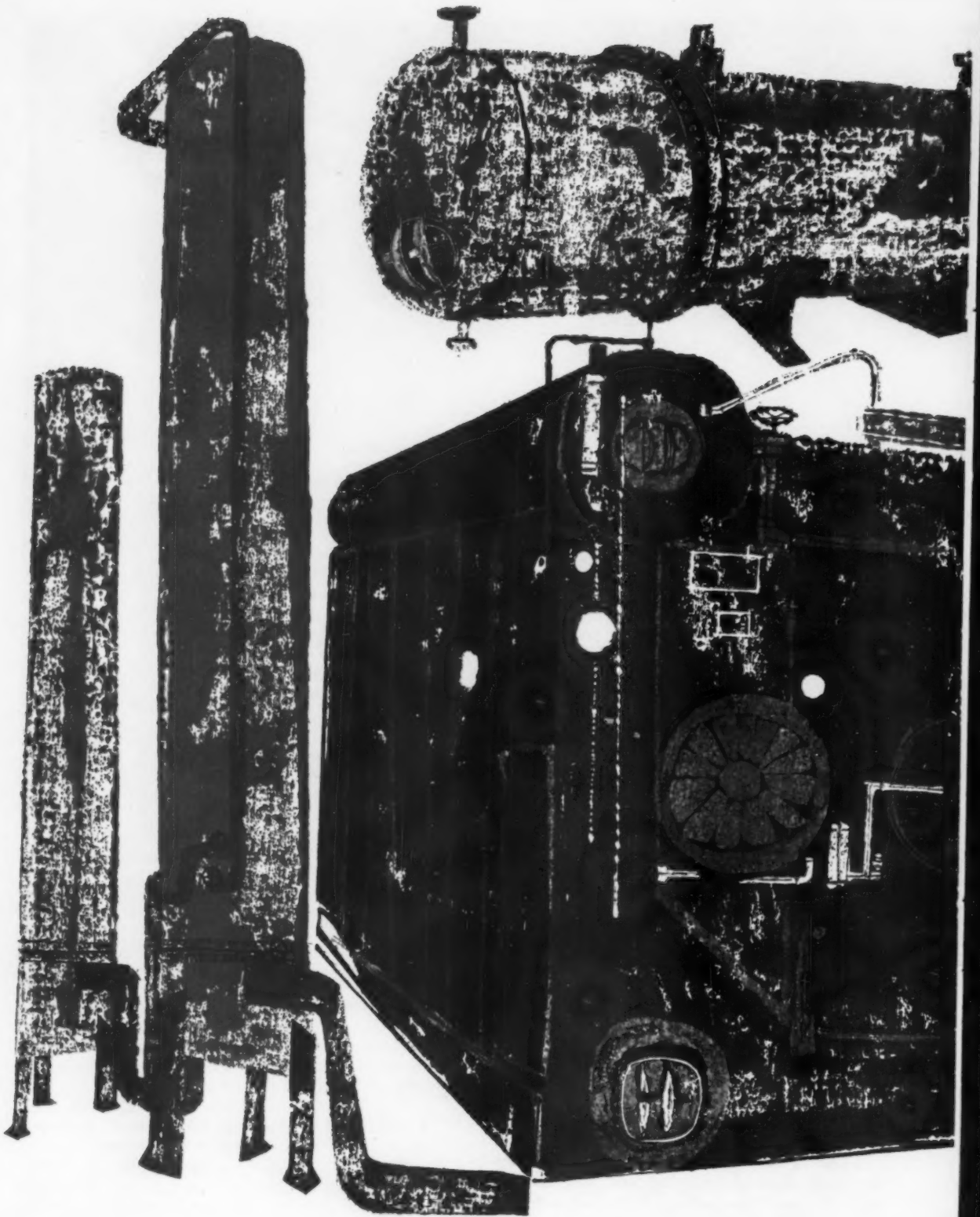
A modern protective device must provide protection against today's heavy fault currents — and be able to protect against even greater fault currents that might develop in the future.

You get this protection with FUSETRON fuses. FUSETRON dual-element fuses have an interrupting rating of 100,000 amperes rms symmetrical.

Electrical Protection goes MODERN with FUSETRON fuses because they are adequate for today's conditions and for anticipated growth in service demands.

For More Information on FUSETRON dual-element fuses . . . *Write for bulletin FIS*

BUSSMANN MFG. DIVISION, McGraw-Edison Co., St. Louis 7, Mo.



POWER PLANT PRODUCTS HEAT ENGINEERED BY FOSTER WHEELER:

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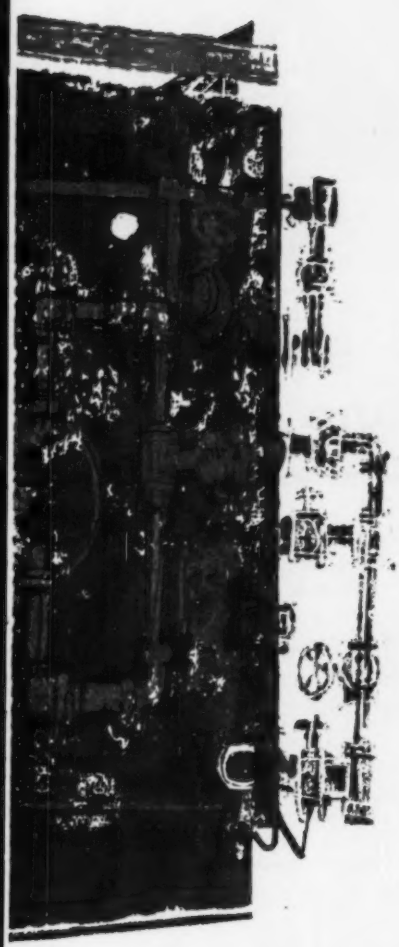

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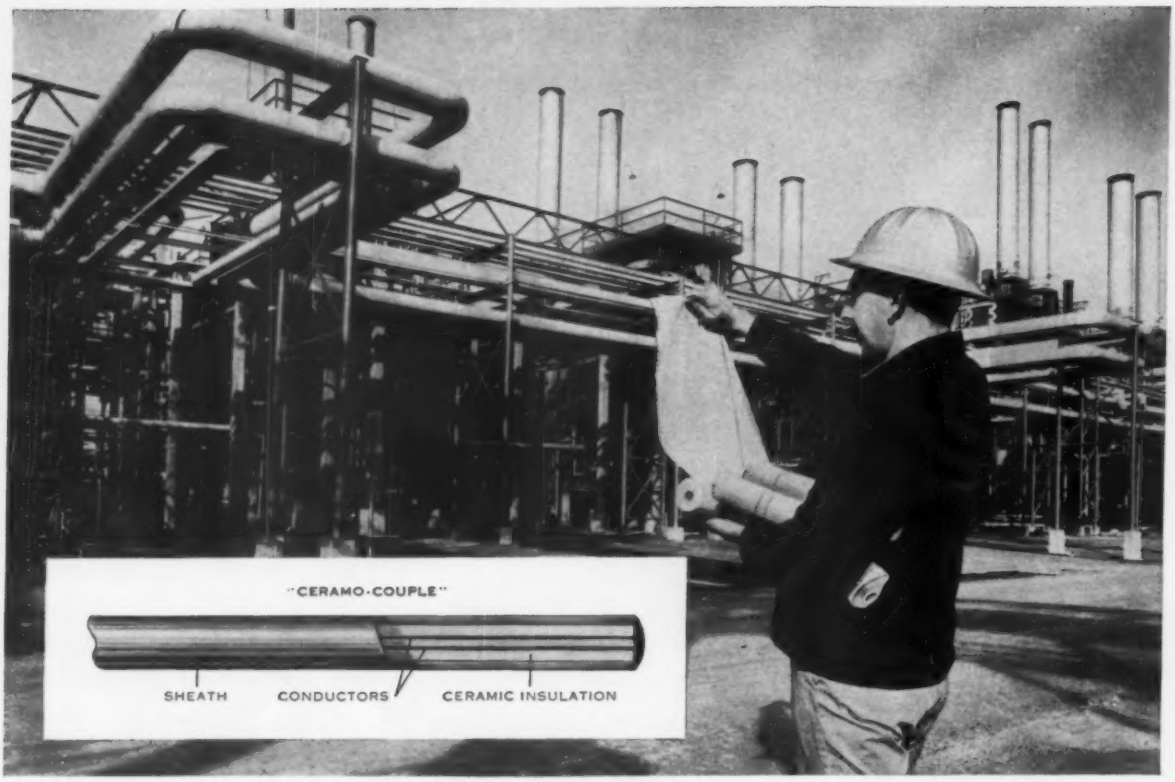

Process engineer at Sun Oil Refinery examining temperature measurements from "Ceramo" thermocouples.

Ceramo® Thermocouples Help Sun Oil Prevent Furnace Tube Failure

Thermo Electric's Versatile "Ceramo" Solves Another Problem

The Sun Oil Company refinery at Marcus Hook, Pa., found the answer to a difficult problem—preventing tube failure in their process heaters—with T-E's "Ceramo-Couples."

As coking and scaling build up within these tubes, heat transfer is reduced and tube temperatures rise. Unchecked, this condition can eventually result in costly, unscheduled shutdowns and potentially dangerous tube rupture.

Sun Oil also had another problem—rapid thermocouple failure. To measure tube skin temperatures from 500—1200° F. and withstand furnace temperatures to 1800° F., they were using 8-gage, insulated, pencil-type T/C's without protection tubes. Wires became brittle and soon broke. Hot junctions separated from the tube wall and read gas instead of tube temperatures. Process engineers had no confidence in readings. Costly, time-consuming installation of new T/C's was needed after every furnace shut-down.

Sun Oil went looking for a better thermocouple. They found it in T-E's "Ceramo"—ceramic insulated conductors encased in overall metal sheathing. Their 3/16" O. D. "Ceramo-Couples" have 20-gage Chromel-Alumel conductors and stainless steel sheathing. Thermocouple life was greatly increased, replacement was cut in half. Reliable readings from "Ceramo" permitted operation of process heaters at higher temperatures—thereby increasing production. "Ceramo's" ability to be bent on a small radius without shorting or grounding simplified installation. And "Ceramo" flexed with the differential motion between tubes and furnace walls.

Sun Oil now has about 300 "Ceramo-Couples" in use at Marcus Hook in 5 to 32 ft. lengths. During the 5 years "Ceramo" has been in use, Sun Oil has had no furnace tube failure or unscheduled shut-downs from faulty temperature measurement.

If you have problems of high temperature, moisture, abrasion, corrosion or difficult installation, investigate T-E's "Ceramo." Only "Ceramo" has the quality of materials and construction to meet all these needs.

Write For EDS-45-21

Thermo Electric CO., INC.
SADDLE BROOK, NEW JERSEY
In Canada: THERMO ELECTRIC (Canada) LTD., Brampton, Ontario

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Hall Industrial Water Report

VOLUME 8 FEBRUARY 1960 NUMBER 1

Don't Carry Things Too Far

This familiar expression predicts trouble. Just as trouble with deposits comes when steam carries droplets of boiler water too far—out of the boiler steam drum into superheaters, turbines, heat exchangers and heating systems. Superheater tubes burn out, turbines lose efficiency and capacity, and heat transfer suffers.

Hall engineers know how to combat carryover problems. They are familiar with the mechanical methods of purifying steam and know how to determine whether antifoams are also needed. They can help you to improve steam quality just as they can serve you on other water problems in the steam plant, or in cooling process or waste water disposal facilities.

Spreading Oil on the Water

At a southern synthetic fiber mill serious fouling of a turbine with water-soluble deposits required washing at intervals of approximately three months. This puzzled Hall engineer T. A. McConomy no end because normally his checks on steam showed it to be of good quality. Furthermore, he could find no place in the mill where the condensate, makeup water or boiler feedwater was being contaminated. The use of antifoams in the boiler water did not improve conditions.

One day heavy carryover occurred —so heavy that steam temperature temporarily dropped almost 100°F. The alert operators collected samples of boiler water. Analysis showed one to contain 28 ppm of ether-extractable material and the other an astounding 1185 ppm. Infrared analysis showed the ether-soluble material to be largely lubricating oil.

What was the source of the oil? Previous investigation had ruled out the mill. McConomy asked the operators to keep a careful watch on the river water at the plant intake. A few days later an oil slick showed up.

It was now easy to trace the source of contamination upstream to several service stations and small manufacturing plants which were dumping oil into the river. The job of getting them to stop was harder. So the filter plant operator now has an extra duty called "river watching." This makes possible the diversion of oil-contaminated water from the steam plant, and saves the cost of additional, expensive equipment.

Baffling Leaks

Carryover was so bad in a midwestern automobile body plant that steam traps were continually plugging and a turbine-driven air compressor couldn't produce at rated capacity. It was determined that one boiler of three was causing all of the trouble.

Each boiler was put through its paces while steam quality was checked conductometrically by Hall engineer L. P. Dougherty. Steam from two of the boilers was found to be excellent under all conditions, even when operated at ratings well above normal. The third boiler acted all right until the rating was pushed a little above normal, then gobs of water went out in the steam.

Having proved which boiler was the bad actor, Dougherty asked that it be taken out of service for inspection of steam drum internals. Sure enough, the baffles were found to be hanging loosely, leaving spaces where steam could short-circuit to the offtakes without following the designed path.

Baffles were tightened and the leaks closed up. Additional steam purity checks showed that the repairs were effective. Trouble stopped and has not recurred.

Embrittlement in Steam Line

Failure of steam lines due to caustic embrittlement is almost unheard of. It can occur, however, if the necessary conditions are present. Caustic soda must get into superheated steam to produce a concentrated solution and this solution must contact highly stressed metal.

In one case high-pressure steam was reduced to 60 psi and desuperheated to within 40°F of saturation temperature. Desuperheating water was a mixture of condensate and deionized water. The pH value of the deionized water was adjusted to 9.0-10.0 with caustic soda for protecting uncoated steel pipe from corrosion and for establishing desired alkalinity in the boiler water.

The steam line was welded. Chill rings had been used and there were open spaces between the rings and the internal surface of the line. When desuperheating water was trapped in the spaces, it concentrated to produce a strong caustic solution in contact with the stressed metal in the welds. Cracking and failure occurred.

In this instance the major source of caustic soda was that added to the deionized water. However, sodium leakage or insufficient rinsing after anion exchanger regeneration could supply the caustic soda. Obviously then, deionizers must be operated with this in mind if the water is to be used for desuperheating.

Water is your industry's most important raw material. Use it wisely.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information on how the Hall System can help you solve your particular water problems, write, wire or call address below.

HALL LABORATORIES
HAGAN BUILDING, PITTSBURGH 30, PA.
Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.

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Gate, Non-Return, Globe, Angle "Y", and Check Patterns—All Commercial Sizes—for—150 to 2500 Pounds and Higher; Temperatures—sub zero to 1200 F.

To handle the increasingly higher pressures and temperatures required by modern industry, Powell offers the highest quality steel valves with many exclusive Powell features of superior design and construction.

Many of these Powell Valves are stocked for quick delivery. Contact your city's Powell Valve distributor. Or write directly to us. Our engineers will quickly solve your flow control problems encountered in handling water, oil, gas, air, steam, corrosive fluids.

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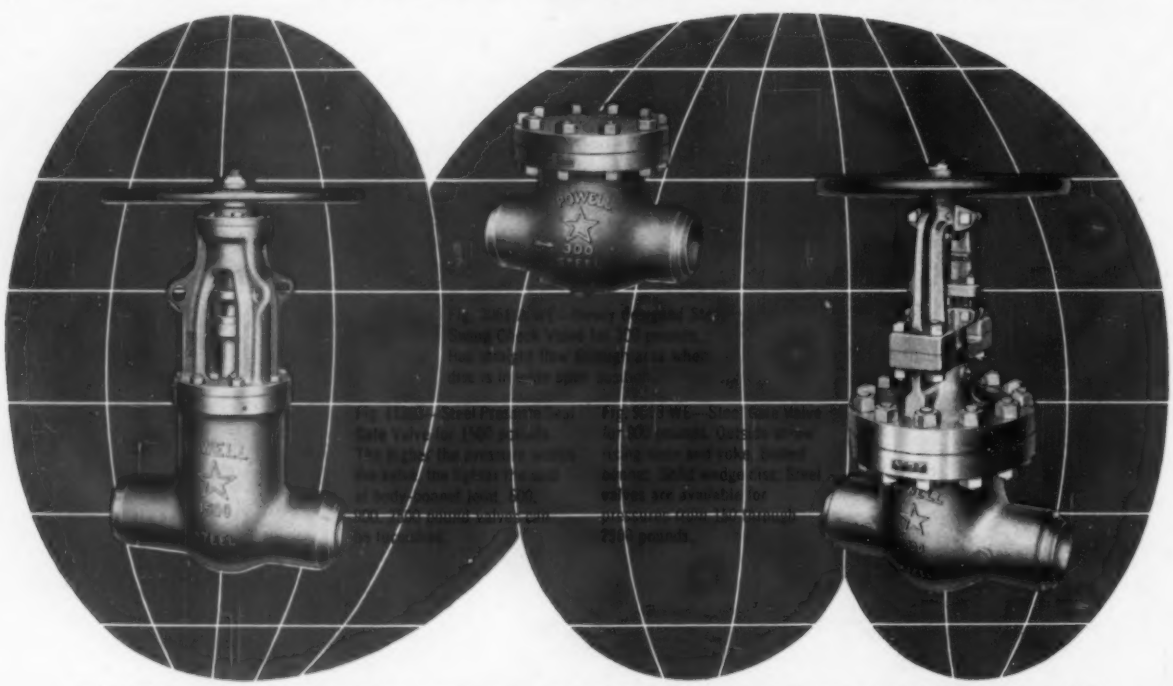

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HELPFUL BULLETINS

PUMPS, COMPRESSORS

101 General Purpose Pumps — Twelve-pp Bulletin B-2100 describes general purpose, horizontal, centrifugal split-case pumps for hot and cold water handling, circulation and boosting. General characteristics, dimensional data, and selection charts are included, as well as drawings showing construction details. Peerless Pumps Div., Food Machinery and Chemical Corp.

102 Metering Pumps — Introduced in this 12-pp catalog is manufacturer's Series 200 metering pump, an electrically driven pump of positive displacement, reciprocating, plunger type, capacities from 0.65 to 2025 gph. Design and operating features, possible arrangements and standard materials of construction are covered, and dimensions and selection data provided. Wallace & Tiernan Inc.

103 High-Vacuum Pump — Application of vacuum technology in a variety of fields is detailed in 16-pp Bulletin 8-20. Design and operation of company's high vacuum pump are described, and cross-sectional views, operating diagram, table of operating characteristics, speed curves, and dimensional data and diagrams included. Consolidated Vacuum Corp.

104 Leak-Proof Pumps — Bulletin 1080 describes a line of two-stage, high-head leak-proof "canned" pumps for heads up to 600 ft. Included are general specifications, performance curves and dimensions. Chempump Div., Fostoria Corp.

105 Seal-less Pumps — Bulletin 1100 describes a line of seal-less pumps designed for leak-proof pumping. Covers design, operation, and selection of proper "canned" pump. Chempump Div., Fostoria Corp.

106 Packaged Compressors—Eight-pp Bulletin 91 describes construction and operating features of packaged compressors for gas gathering. Construction details are given on the two-throw type and the four-throw type, and compressor cylinders for a wide range of applications are listed. The Cooper-Bessemer Corp.

MECHANICAL POWER TRANSMISSION

107 Motor Reducers — Construction and mechanical features of motor reducers for use with blowers, compressors, conveyors, cranes, hoists, elevators, machine tools, rotary mills, mixers and stokers in a variety of industries are detailed in 30-pp Catalog MR-58. Load characteristics are outlined, including horsepower and torque ratings, overhung loads and maximum allowable thrust loads, mounting dimensions. Philadelphia Gear Corp.

108 Improved Drives — Catalog GB-201-A contains 58 pp of selection data on Gearbelt drives which combine the flexibility of belt drives with advantages of chain and gear drives. In addition to specifications, it contains design and installation suggestions, engineering data, and selection tables. Browning Mfg. Co.

109 Variable-Speed Sheave — Bulletin 6102, 8-pp, describes the stationary control SVS variable-speed sheave for V-belts available with two, three or four grooves. Features detailed include non-freezing, non-lubricating construction, method of installation, and speed change. Tables are given to aid in selection. T. B. Wood's Sons Co.

VALVES AND FITTINGS

110 Butterfly Valves — Iron body, rubber seated butterfly valves and operators are featured in 36-pp Bulletin 5904. Valves are designed for hydrostatic operating pressures up to 125 psi and velocities up to 16 ft per sec. Booklet gives data on construction and design, dimensions, general hydraulic data, materials and methods of operation. Darling Valve & Mfg. Co.

111 Nylon Disc Gate Valve — Bulletin NP-76E describes features and advantages of company's nylon disc gate valve which offers resistance to a wide range of chemicals. Engineering data and specifications are also given in Chemical Chart No. 76. OPW-Jordan.

112 Butterfly Valves — Illustrated and described in Bulletin 10 EA are rubber seat butterfly valves designed to mount between pipe flanges. Complete specifications, certified dimension drawings, water flow data, gas flow data, weights and freight rates, and prices are included. Henry Pratt Co.

113 Magnetic Valves — Featured in Bulletins 85-D through 103-D are magnetic valves for the control of water, oil, brine, air, solvents, gas, steam. Application, construction and operation details are presented, along with dimensional diagrams, photos, selection data, and comparative tables of fluid discharge and friction drop. Magnatrol Valve Corp.

114 Air Control Valve — The PDQ air control valve is described and specifications given in Bulletin 594. Tells how to replace entire valve in 30 sec. and to repack valve and pilot section in 1 min without tools. The ½-in. valve has two replacement parts, each self-contained. Cutaway and mounting views, dimensions and applications are included. Hunt Valve Co.

115 Control Valve — Described in Bulletin WC-122 is a single control valve designed to perform the functions of a nest of valves controlling the flow of liquid in zeolite softeners, ion exchange units and filters. Design and operating features are detailed. Graver Water Conditioning Co.

116 Filtration Plant Valves — Filter drain valves, backwash valves and rewash valves for filtration plants are illustrated and described in 8-pp Bulletin W-18. Features are shown on cutaway diagram, and installation details and dimensional data included. Golden-Anderson Valve Specialty Co.

117 Valve, Fittings — Valves and fittings for 30,000 and 60,000 psi are detailed in 16-pp Catalog 659. Included are dimensional data, cross-sectional drawings, tubing sizes and catalog designations for standard valves and fittings: valves and various couplings, adapters, tees, crosses, gauge connectors, safety head assemblies and nipples. Catalog gives information on four types of thermocouple adapters and a relief valve, in addition to standard connections for ⅛ to 9/16-in. O.D. High Pressure Equipment Co., Inc.

118 Pipe-Thread Fittings — Tru-Seal fittings designed to provide speedy positioning and freedom from leakage, and eliminate overtightening damage in assembling piping, valve and pump installations are described in this bulletin. Common types of positioning, distortion, alignment, reworking and leakage problems and their solutions are illustrated. Tru-Seal Div., Flick-Reedy Corp.

119 Swing Joints — Catalog F-8 contains 12 pp of design and engineering data on swing joints designed for a wide range of applications. Detailed specifications and dimensional data are included. Jordan Corp.

BOILERS, AUXILIARIES

121 Water Tube Boilers — Catalog SB-57R contains 20 pp of detailed information on company's two-drum water tube factory assembled boilers. Sectional views, dimensional drawings and mechanical data on the oil, gas or coal-fired units included. Erie City Iron Works.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 109 and 110.

122 Firing Equipment — Twelve-pp Catalog 6260 covers automatic firing equipment for heating, processing and power, including oil burners, gas burners, dual-fuel burners for gas and oil, forced draft package units, boiler-burner units, coal stokers, factory-wired combustion control panels, etc. Index and selection chart simplify choice of appropriate equipment. Iron Fireman Mfg. Co.

ELECTRICAL

123 Torque Motors — Standard and special torque motors designed to exert maximum rated torque are featured in Bulletin 208A. Technical data includes torque motor characteristics, typical applications, duty specifications, sizes and ratings, as well as comparative speed-torque curves. The Ohio Electric Mfg. Co.

124 For Slip Stem Valves — Featured in 8-pp Specification S1016-2 are Actionator motors, with integral strain release and yoke assembly, designed to operate a wide range of slip stem valves. Detailed specifications are given. Minneapolis-Honeywell Regulator Co.

125 General Purpose Controls — Catalog 1260D, 72 pp, contains information on general purpose control devices. Charts are listed for motors from ¼ through 200 hp, affording quick selection of heaters and push button stations. Product descriptions are provided for both manual and magnetic motor starters, relays, solenoids, limit switches, push buttons, static control and pilot devices. Pricing tables are included, also information on features, wiring, dimensions and application of each device. Available supplemental bulletins are listed for each product type. General Electric Co.

126 Circuit Breakers — Low voltage stored-energy power circuit breakers are discussed in a 20-pp Bulletin GEA-5915E. Includes photographs, diagrams, graphs, charts showing specifications, operating features, dimensions, ratings for low voltage power circuit breakers and applications. Manual and electrical stored-energy closing mechanisms are described in a range of ratings through 600 v, 4000 amp. General Electric Co.

127 Molded Case Circuit Breakers — Illustrated 40-pp Bulletin 5001-1A contains ratings, specifications and operating characteristics on a diversified line of molded case circuit breakers. Pictures and describes molded case circuit breakers ranging from the smallest, for lighting circuit protection, through 100,000-amp capacity breakers and special-purpose breakers. I-T-E Circuit Breaker Co.

128 Fuse Cutouts — Eight-pp Bulletin FC3 describes features and advantages of fuse cutouts rated 100 amp at 7.8, 15 and 27 kv. Application data, dimensional and ordering information is presented. Line Material Industries, McGraw-Edison Co.

129 Power Panelboards — Design and operation of fusible power panelboards designed to confine and control arcing through a combination of four interruption methods are detailed in 18-pp Bulletin VBP-470. Layout procedure is diagrammed, circuit selection tables included, along with suggested specifications and other information. Bulldog Electric Products Div., I-T-E Circuit Breaker Co.

130 Distribution Transformers — Overhead-type conventional distribution transformers are described in 28-pp Bulletin DT2. Covers standards, application information, design and operating features, and specifications. Line Material Industries, McGraw-Edison Co.

131 High Frequency Duct — This 12-pp Booklet B-7326 describes the high-frequency bus duct, outlines features and contains a curve of voltage drop at 400 cycles per sec plotted against load. Also included are: fittings, dimensions, and specifications. Westinghouse Electric Corp.

132 Silicon Rectifiers — Eight-pp Bulletin 6101-1A contains details on the Unitron, a unified power conversion system consisting of a silicon rectifier unit, transformer and associated auxiliary equipment. Design features which permit a wide range of applications are detailed. I-T-E Circuit Breaker Co.

133 Silicon-Rectifier Chargers — Technical data on constant-voltage, silicon-rectifier chargers for stationary-type batteries are presented in Data Sheets Section 90.41, 90.44, and 45. Including curves and statistics on charger performance at various electrical loads, data sheets also contain diagrams and instructions for installing associated alarms and ground detection systems. Exide Industrial Div., The Electric Storage Battery Co.

134 Frequency Meters — Advantages of company's resonant reed frequency meters are discussed in 18-pp Bulletin 32. Discusses the vibrating reed principle, includes selection chart, temperature correction curves, specifications and mounting dimensions, information on how to read the scale, and application data. James G. Biddle Co.

135 Solderless Connectors — Featured in Catalog 85, 8-pp, are pre-Sure connectors for wire splicing and terminating, also sectional and one-piece terminal blocks. Covers squeeze-type Romex connectors, insulated conduit bushings, knockout plugs and cable staples. Advantages of splice caps, snap-on nylon insulators and Termend lugs, are given. Buchanan Electrical Products Corp.

HEAT TRANSFER

136 Heat Transfer Equipment — Design and construction features of company's heat transfer equipment are detailed in 20-pp Bulletin HE-8. Covers positive seal baffle, film type heat exchangers, waste heat boilers, high pressure and high temperature heat exchangers, heat exchangers of special alloy metals, and others. Henry Vogt Machine Co.

137 For Heat Transfer, Processing — Bulletin 820 contains 8 pp describing company's line of chemical process and heat exchange equipment. Features heat transfer equipment, reactors, mixers, kettles and special process machinery. Manning & Lewis Engineering Co.

138 Heat Exchanger Tube — This 8-pp brochure outlines principal features, technical information, composition and applicable specifications for company's heat exchanger tube alloys for use in power, petrochemical and related fields. Includes technical section on the use of copper alloy tubes in condensers and heat exchangers. Scovill Mfg. Co.

139 Plate Heat Exchanger — This 12-pp brochure describes a complete line of plate heat exchangers for use in small plants, medium size plants and high capacity plants. Features and advantages are detailed. De Laval Separator Co.

INSTRUMENTS AND CONTROLS

140 Transmitting Rotameters — Bulletin 18N describes the pneumatic Model 58, a position-balance type instrument transmitting air signals proportionally to fluid rates of flow to remotely-located indicators, recorders, controllers or integrators. This transmitter is mounted directly on and coupled to the rotameter to sense rotameter-measured fluid rate of flow. Photos, drawings, characteristics, dimensions, ranges, construction, operation, and applications are included. Schutte & Koerting Co.

141 Pre-Engineered Servo Systems — Bulletin 59-75 describes advantages of the "building block" concept using standard hydraulic and electrical components pre-engineered into servo systems. Typical applications are noted. Vickers Inc., Div. Sperry Rand Corp.

142 Motion Indicator — Described in Bulletin RG-21 is a positive motion indicator, a machinery safeguarding mechanism designed to convert rotary motion into an electrical signal. Specifications, ordering instructions, and installation data included. The Bin-Dicator Co.

143 Computers, Accessories — Descriptions of general and special analog computers and accessories are given in this brochure. Computers with 80 and 120 amplifiers, electronic multipliers, data plotting boards, linear programming computers and a computer technology, the Dystac system are included. System incorporates iterative capability of digital computers while maintaining the speed and ease of analogs. Computer Systems, Inc.

144 Gas Sampling Systems — Information on company's Series 651 gas sampling systems is contained in 8-pp Publication 59-B651. This is a "package" method of sampling systems developed to provide efficient gas-sampling service at moderate cost. Bulletin gives a step-by-step procedure for selecting the components of a specific sampling system and lists typical ones for specific applications. The Hays Corp.

145 Waste Treatment Instrumentation — Case histories showing how instruments are applied to industrial waste treatment systems to prevent stream pollution are presented in 26-pp Bulletin B97-2. Photos and schematic diagrams illustrate details. Minneapolis-Honeywell Regulator Co.

WELDING

146 Welding Electrodes — The 64-pp Electrode Pocket Guide contains information on all types of electrodes, including mild steel, low alloy, low hydrogen, iron powder, stainless steel, hardfacing, nonferrous and cast iron. Covers applications, procedures and pertinent data on each electrode, includes charts of recommended electrodes for welding various steels, and tables for mild steel and hardfacing electrodes. Air Reduction Sales Co., Div. Air Reduction Co., Inc.

You'll save time in ordering bulletins by using the Reader Service Cards on page 109. Of course we honor letterhead requests—but it takes us somewhat longer to handle them.

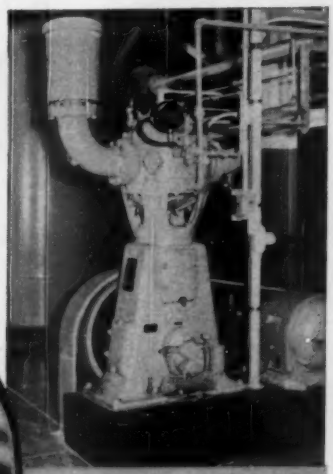
147 Guide to Preheat — Welding of low-alloy high-tensile steel and other alloy steels with the aid of preheat is explained in 40-pp "A Guide To Preheat." Physical and chemical changes that take place in these problem steels during and immediately after welding are outlined. J. B. Nottingham & Co., Inc.

WATER TREATING

148 Sodium Zeolite Softeners — Described in 12-pp Bulletin 4520 is the sodium zeolite process of water softening. Includes information on selecting and sizing of equipment, automatic vs manual

Joy Design Means:

CHROME-PLATED CYLINDER WALLS FOR CORROSION RESISTANCE



Joy WGO-9 Compressors supply instrument air in southwestern power station.

Chrome-plated cylinder walls give Joy Oil-Free Compressors longer service life and lower maintenance costs. The intermittant duty typical of oil-free compressor service makes rusting of the cylinders a prime source of trouble. Because of the exclusive replaceable cylinder liner construction, Joy is able to put a chrome face on the cylinder wall which will resist corrosion and also give extra wear. This feature and the exclusive T-Block carbon-graphite compression ring construction make Joy Oil-Free Compressors economical to operate.

Joy can supply positive displacement machines with capacities up to 7392 CFM and dynamic machines in any size desired. For complete details on how to get truly low cost, oil-free air, consult your Joy representative, or write for Bulletin 926-56C.

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ANY SIZE

from ½" to 12" I.D.

STRAIGHT or CURVED

Roto engineers are constantly designing new equipment to meet new conditions and applications for its tube cleaners. If you have a pipe or tube cleaning problem, we will be pleased to place our long specialized experience at your disposal. Write, wire or

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Illustrated are a few of the many types and sizes of Rotojet Tube Cleaners driven by air, steam or water. We analyze each application before recommending equipment that best meets the requirement.

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controls and calculations of softening capacity. Cochrane Corp.

149 Demineralization Process — This Bulletin 5819 describes Uni-Pac, a packaged mixed bed demineralizer for process water applications ranging up to 13,200 gph. Information on use of process eliminating variables in water and effects on product quality control is included. Cochrane Corp.

CORROSION PREVENTION

150 Anti-Moisture Treatment — This bulletin describes a liquid inhibitor that displaces and seals out water and moisture, protects metal surfaces against corrosion, and lubricates. Applications include maintenance use in electrical and electronic equipment. Bulletin tells how formula works, discusses its benefits and uses, physical specifications. Corrosion Reaction Consultants, Inc.

151 Protective Coatings — This 38-pp comprehensive treatise (Form 259) on rust and corrosion control by protective coatings contains a gate-fold spread showing actual color standards of company's primers and top coatings. Covering water resistant, heat resistant, floor coatings, heavy-duty chemical resistant coatings, galvanized metal coatings, wire fence roller coatings, and quick-dry coatings, bulletin contains full-color application photos and 110 color chips, and technical section giving data on surface preparation, types of surfaces, application techniques, how to estimate gallonage needed, other information. Rust-Oleum Corp.

152 Cathodic Protection System — Causes of corrosion and principles of cathodic protection are detailed in this 12-pp bulletin. Covers cathodic protection for pipe lines, and for water works equipment such as tanks, clarifiers, flocculators, filters. The Harco Corp.

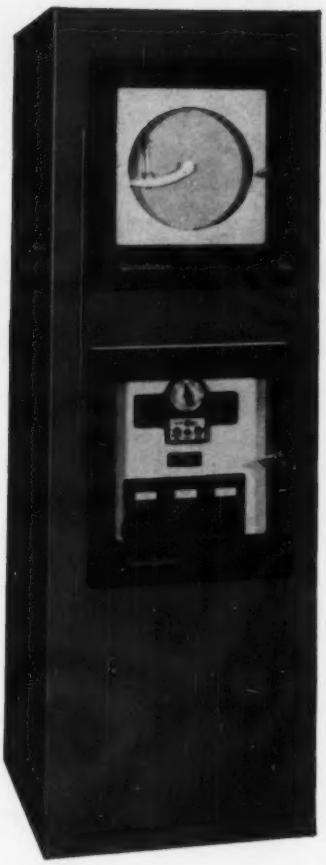
OTHER EQUIPMENT

153 Fire Extinguishing Equipment — Featured in 20-pp Catalog 1960 is a complete line of fire fighting equipment, including hand portable extinguishers, stationary fire equipment, piped systems, and large capacity mobile equipment such as fire jeeps and trucks. Capacity data on various types of fire extinguishers and other equipment are presented. Ansul Chemical Co.

154 On Coal Handling — Sixteen-pp Booklet A-2029 discusses methods of handling coal in today's steam generating plants. Importance of coal handling equipment in relation to over-all power plant design is covered. Link-Belt Co.

155 On Gasket Leakage — Technical Paper 139, entitled "Some Causes of Boiler Gasket Leakage" provides little known facts to help minimize a common, annoying problem. Betz Laboratories, Inc.

156 Thermal Insulation — Described in 54-pp Catalog IN-244A are thermal insulations for all types of commercial and industrial requirements ranging from −400 to 3000 F. Contains six sections, each devoted to a specialized group of thermal insulations, including industrial and high temperature; plumbing, heating and air conditioning; refrigeration; insulating firebrick and refractories; finishes and weatherproofing ma-



AUTOMATIC COLORIMETRIC ANALYSIS

in the parts per billion range

Now you can perform delicate colorimetric analyses for silica and other parts per billion trace contaminants right on the plant floor . . . without supervision. Quantichem® Analyzers continuously, automatically perform every step of a wet laboratory analysis with unprecedented accuracy and dependability. The field-proved Quantichem analyzer is so stable and foolproof that it actually provides *greater accuracy and repeatability than tedious manual techniques.*

The first step in each Quantichem analysis is standardization, in which *sample* and *zero* cells are flushed with sample while the instrument zeroes itself. Although no Quantichem analyzer has yet exhibited so much as 1% drift in 24 hours, standardization is a valuable safety feature. It ensures results *independent of photoelectric tube characteristics, line voltage variation, sample turbidity, or dirt on the cell windows.* If a dirty cell window or failing light source prevents zeroing, an automatic signal is actuated.

After standardization, the pneumatic programming drum which controls the instrument actuates the unique Minus Delta P® diaphragm metering pumps. Precise amounts of as many as four reagents (within ±0.25%) are delivered to the cells in the desired sequence. The analysis reaction is permitted to go to completion, *eliminating any chance of temperature or timing errors.* The dual beam optical system which illuminates both cells ensures uniform light intensity and *eliminates possible errors due to light source inequality.*

Any difference in light intensity transmitted by the two cells unbalances the measuring bridge circuit, actuating the Quantichem recorder and associated instrumentation. Then a new analysis cycle begins with flushing of the cells and standardization.

Quantichem analyzers are now available for dissolved silica, dissolved oxygen, hydrazine, total hardness, residual chlorine, dissolved iron, and other trace determinations. Most analyses are accurate to within ±3% of full scale, and sensitive to ±1% of full scale. Designed and built to take tough industrial usage, Quantichem analyzers provide long service life with minimum maintenance. All wetted parts are constructed of corrosion-proof materials.

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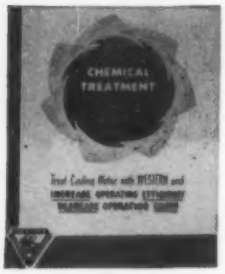

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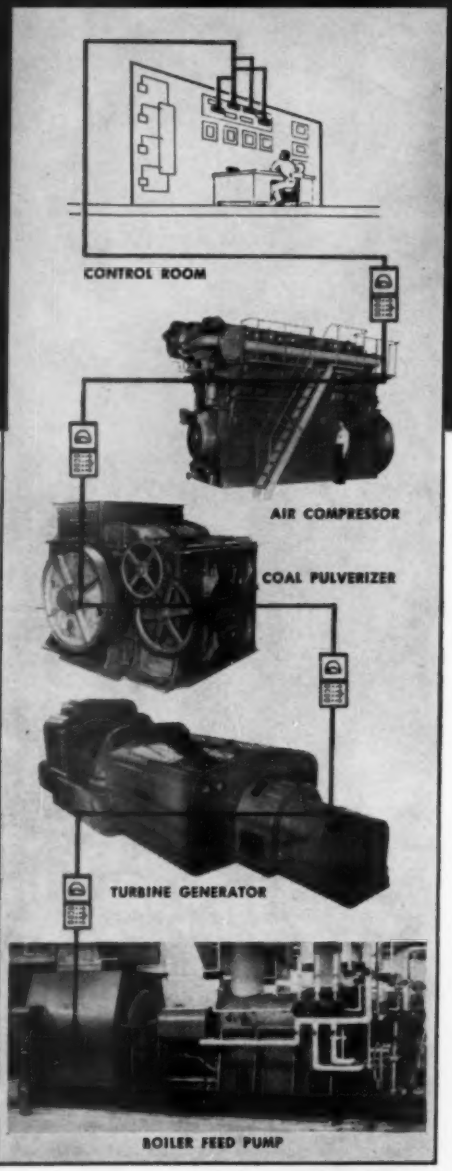

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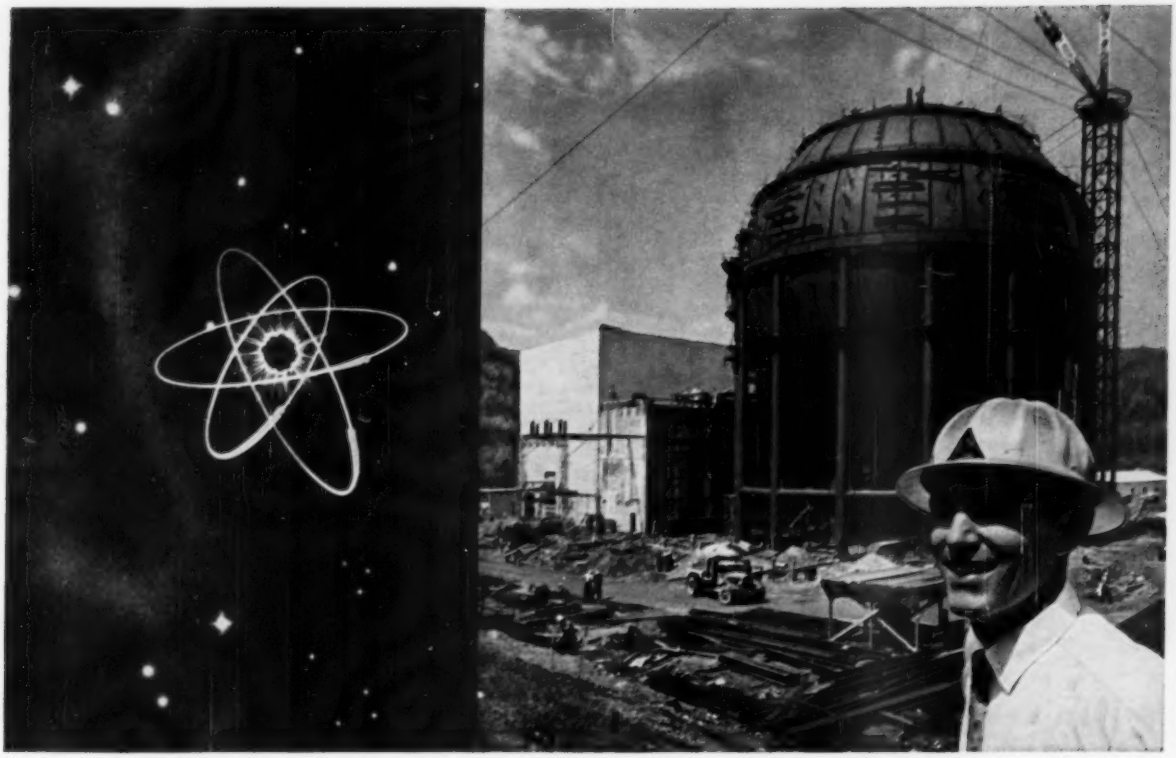

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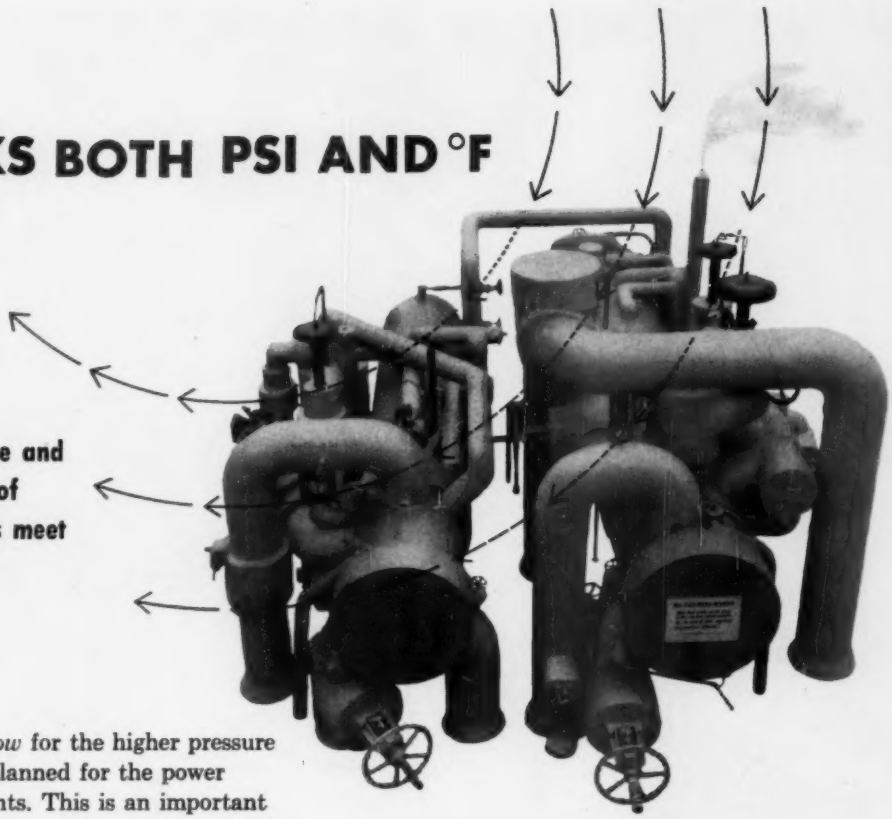

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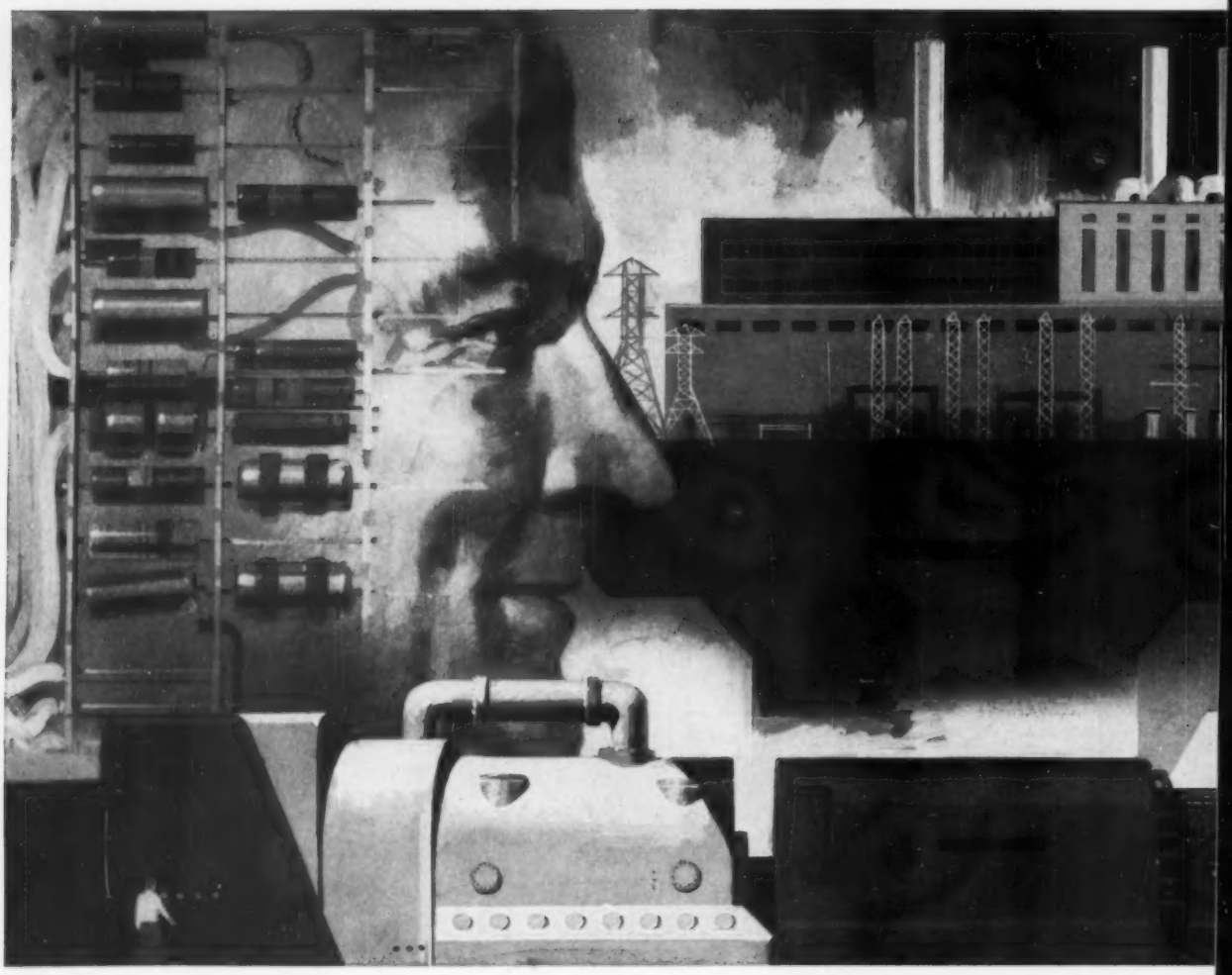

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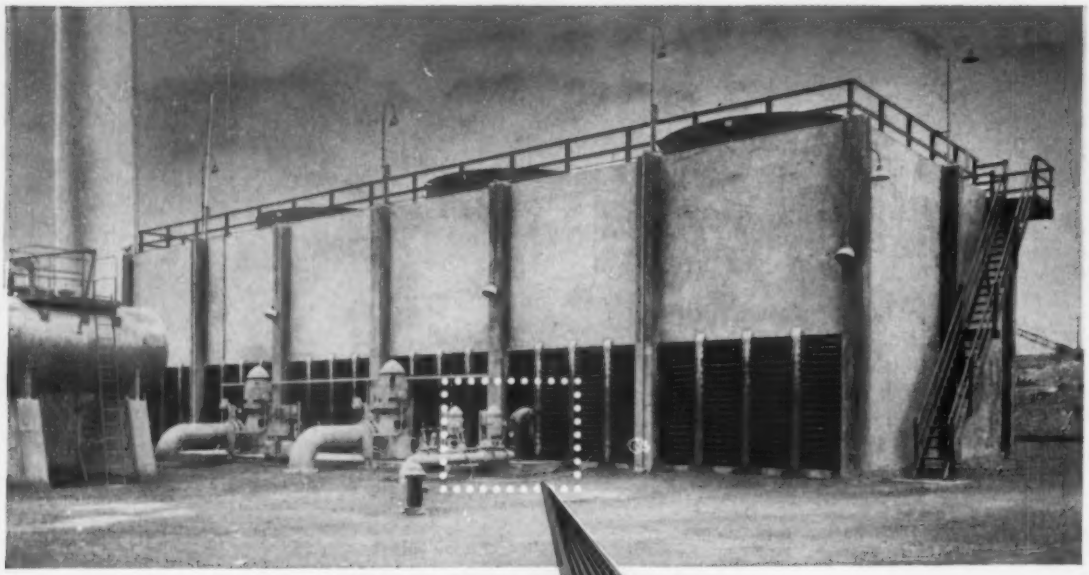

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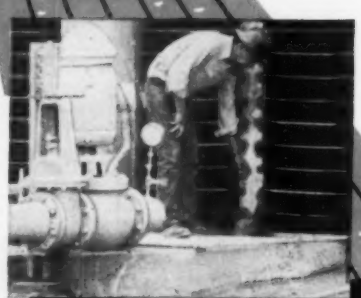

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ATOMICS

A section of POWER ENGINEERING covering current and forthcoming developments in the field of Nuclear Power throughout the world

ANDREW W. KRAMER
Editor

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Why has nuclear power development in the United States not been more rapid? One factor involves the absence of reliable cost data on which to estimate the cost of commercial nuclear power plants. Another factor concerns utility operators' reluctance to participate in nuclear power plant construction until high steam temperatures can be attained in nuclear plants.

Nuclear Power—The World Over
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An up-to-date summary of nuclear power development throughout the world. Although the United States, England, and Russia lead the world in nuclear power development, many other countries have ambitious nuclear power programs under way.

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NUCLEAR POWER ECONOMICS

IN A RECENT STUDY of the commercial feasibility of small-size nuclear power plants made by the AEC, the power costs of a 22-Mw (e) PWR plant were compared with power costs of a similar size conventional plant. The total generating cost for the two plants was 16.9 and 10.9 mills per kwh, respectively; the nuclear power cost was considerably higher than the cost of conventional power. However, in the evaluation of these costs, both the fixed charges and the operating and maintenance charges for the nuclear plant were assumed to be considerably higher than for the conventional plant. The report indicated that lack of experience was responsible for the higher O & M cost assumed for the nuclear plant and that the higher fixed charges were due to the higher insurance rate on the nuclear plant.

These AEC cost estimates are realistic, but they are typical of most nuclear cost estimates made in recent years; they reflect the dearth of actual data on which to base power costs. Until a sufficient number of commercial nuclear power plants have been built and operated long enough to provide actual cost data, nuclear power costs will remain nebulous. The AEC report admits that there is every reason to believe that the high fixed charges and high O & M costs will be substantially reduced as experience accumulates. Lack of operating experience coupled with a general tendency to regard present costs as reliable, however, is undoubtedly responsible for the apathy with which nuclear power has been regarded in the United States by utility operators.

There are, of course, many other factors which prevent more rapid nuclear power development in the United States, but in the final analysis most of these factors involve economic considerations. There is, for example, the attitude towards higher temperatures. Utility engineers seem to place an extraordinarily high value on the use of high temperatures in thermodynamic cycles. High steam temperatures mean high thermal efficiency; consequently many utility engineers feel that to go back to the use of saturated steam, with correspondingly lower thermal efficiency, would be a step backwards. Hence, they seem to be content to wait until the time when high-temperature nuclear plants become feasible.

Considerable work is in progress toward the development of nuclear superheat; indeed, nuclear superheat has been attained experimentally both at the Sodium Reactor Experiment (SRE) and at the Vallecitos plant of the General Electric Co. With the development of reactors with integral nuclear superheaters, it will become possible to generate steam at 1000 F. In the present state of nuclear reactor technology, however, reactor concepts involving high temperature are very expensive and, as pointed out by Dr. Chauncey Starr of Atomics International, "it is interesting, therefore, that within the utility industry, the high temperature myth has caused automatic acceptance of reactor concepts with a high temperature potential, without the industry's customary cautious examination of over-all economics."

Andrew W. Kramer

NUCLEAR POWER— The World Over

Although England, Russia, and the United States lead the world in the development of nuclear power, many other countries have nuclear power programs in various stages of development. Some time during the 1960s, nuclear power is expected to become competitive with conventional power in many areas

By **ANDREW W. KRAMER**
Editor **ATOMICS**

DESPITE the many complex factors that influence the more rapid development of nuclear power here and abroad, the year 1959 witnessed tremendous continued interest and substantial progress in this field the world over. Much of the mystery and glamour which surrounded the earlier phases of atomic power development has given way to a more realistic appraisal of its merits both with respect to its present and long-range possibilities. The early popular notion that atomic power would bring electricity at little or no cost to the public has been effectively dispelled, but at the same time there is general agreement that future nuclear power costs will be somewhat lower than conventional plant power costs. Some time during the 1960s, nuclear power will become competitive with power from coal, oil, and gas in many areas, depending upon local fuel costs.[1]

Although interest in the development of various reactor concepts continues, the practical development of nuclear power for commercial use has narrowed down to the adoption of two main types of reactor systems, the water-cooled type in the United States and the gas-cooled reactor in Great Britain. Under the AEC's Power Reactor Demonstration Program, other reactor concepts are under intensive experimental investigation, but as already indicated, it is generally agreed that the practical application of these other reactor concepts lies a number of years ahead.

Nuclear Power in Britain

The most intensive development of nuclear power is in England.[2] The magnitude of the British effort, considering the small size of the country, is difficult to realize until it is compared with what we are doing in the United States. Harwell, for example, has more research reactors than Oak Ridge and Argonne combined, and its operations are now being extended to a new site. Calder Hall Station, which has been in operation since 1956, now has four 200-Mw, thermal, reactors in operation, but Calder Hall is small in comparison with the four enormous nuclear power stations under construction or in operation. Hinkley Point Station in Somerset, with two reactors totaling 500 Mw, net (e), has almost the combined electrical capacity of Shippingport, Dresden, Indian Point, Fermi, and Yankee nuclear power stations in the United States. Chapelcross, Dunfriesshire, Britain's second nuclear power station, with three reactors in operation, expects to bring the fourth reactor to full power next month. These stations comprise Britain's first generation of nuclear power plants, and all of them will be in full power or partial operation by not later than 1961. The design of a second generation of nuclear stations is under way in England. These are even larger than the plants now in operation or under construction. One of these, to be built on the North Sea coast in Suffolk, will have a capacity of 650 Mw, electrical. The completion of the Suffolk station in 1964 will bring the total installed nuclear capacity in Britain up to around 3400 Mw, (e). However, an even larger nuclear power station than the Suffolk station is being planned. A 475-acre site has been set aside on the Severn River, near the Berkeley station, for the construction of a 1000-Mw (e) nuclear plant. Up to the present over 1 billion kilowatt-hours of electricity have been generated from the first two nuclear plants in England — Calder Hall and Chapelcross. Apart from the time required for scheduled changes of the fuel charge, which has been progressively reduced from 10 weeks to five weeks, the reactors in these plants have operated for about 90 per cent of the possible time. Since future British stations will be able to change their fuel elements under load, there appears to be a good chance that nuclear power stations could achieve very high load factors if the loads are available, as they are likely to be for some time in the United Kingdom.

Western Europe

On the continent in Europe, nuclear plant construction is far less rapid than in England, but during the year, under the Euratom program, five specific nuclear projects were submitted in response to the joint U.S.–Euratom request for statements of intention.[3] These included the SENN project in Italy, on which work has already been started, involving a 160-Mw boiling-water reactor; the Netherlands Province Noord Brabant Electriciteit 150-Mw plant, to be completed in 1963; the 150-Mw Franco-Belgian reactor, to be built near Givet on the Meuse River; the 150-Mw reactor for West Berlin; and the 150-Mw plant of the AKS utility group centered at Stuttgart in West Germany.

These are all future programs. In the meantime in Germany, the first nuclear power at Kahl, near Frankfurt, is under construction and is scheduled to start operation near the end of this year. This is a small unit, a 15-Mw (e) boiling-water reactor furnished by General Electric Co. Of greater interest, however, is Germany's second power reactor because this will be a gas-cooled pebble-bed reactor, the first of its kind. Construction on this plant is to start this spring, and it is to be completed in 1963. The plant will use a mixture of helium and neon as a coolant and will operate at a gas temperature of 1560 F. This reactor is to be built by Brown Boveri of Germany and Krupp.

In Norway, the Halden reactor went critical in June of last year.

ATOMICS

This unit was built by Norway's Institute for Atomic Energy but has been taken over for operation by a 12-nation group of the European Nuclear Energy Agency. The Halden reactor is important because it is the world's first heavy-water boiling reactor, and is the first boiling-water reactor to go into operation in Europe. Although this 20-Mw (th) unit will be used primarily for studying boiling heavy-water systems, it will also produce 15 tons per hr of process steam in its secondary light-water loop. Eventually, this process steam will be used in a pulp and paper mill, probably the first use of process steam in industry from a nuclear reactor.

Although France has had a small 1.7-Mw (e) natural uranium graphite-moderated air-cooled reactor in operation since September, 1956, the first commercial production in France began on April 22, 1959, when G-2, the second reactor at Marcoule, began to feed electricity into the French grid. This incidentally was also the first commercial production of nuclear power in continental Western Europe. G-2 is also a natural uranium graphite-moderated gas-cooled (CO_2) reactor, rated at 200 Mw (th), 32 Mw net (e). Another similar unit (G-3), which went critical in June, was expected to go into full power operation at Marcoule by the end of 1959. Like the Calder Hall and Chapelcross reactors in England, the Marcoule reactors are dual-purpose units built primarily to produce plutonium for national defense.

Spain, so far, has not begun any nuclear power projects, but this country has drawn up preliminary plans for a 20- to 30-Mw (e) power reactor to serve as a pilot plant from which to gain experience and design fuel elements for a large nuclear plant to follow. This first large plant would be a 300-Mw (e) plant built on the Tagus River near Madrid. Fuel costs in Spain are high, and it is felt that nuclear power will be economic with the construction of the first large plants.

Fig. 1 A view in the fuel storage room at Dresden Station. The fuel elements are stored in specially designed racks so that there can be no chance of accidentally forming a critical assembly. The completely loaded Dresden core will hold 488 elements like these shown in the photograph

Nuclear Energy in Soviet Bloc Nations

A very encouraging development in international relations were the reciprocal visits of the American and Soviet atomic scientists and engineers to the respective countries. These visits demonstrated that Russian-American political relations have come a long way since the days (only 5 years ago) when there was virtually no exchange of any scientific information on a political level between the two nations. AEC Chairman John McCone and his group on their visit to the Soviet Union were shown nuclear power plants, nuclear research establishments, and even a uranium mine. The Russian group, on their visit to the United States, were shown all the major nuclear power plants and research establishments, including Los Alamos Scientific Laboratory, the Lawrence Radiation Laboratory, and the Princeton Controlled Thermonuclear Research Laboratory.

As reported by AEC Chairman McCone on his return, one thing that impressed the American group was the speed with which the Soviet scientists and engineers appear to reach a specific objective once they decide it is of major importance to them. For example, at the Soviet atomic laboratory at Obninsk, near Moscow, they were shown an advanced fast-neutron experimental reactor fueled with plutonium oxide. There are no such reactors fueled with plutonium in the United States nor elsewhere in the world, yet this plant was designed and constructed in one year's time. As a second example, the McCone group was told that in ten months the Soviet scientists designed and built the giant controlled thermonuclear experimental machine, known as OGRA, which was first described at the Geneva Conference in September, 1958. As Mr. McCone said upon his return, from what he observed of Soviet dedication, their energy, and their competence, he had no reason to doubt the Russian claims. "In our country," he said, "under procedures that perhaps have become traditional, a like undertaking could take a far longer time."

As in the United States, nuclear power development in Russia is proceeding relatively slowly because the Soviet Union has an abundance of conventional power sources, which does not make nuclear power development particularly urgent. The Russians are trying out a number of different reactor concepts much as we are under the AEC Power Reactor Demonstration Program, with the object of selecting the most feasible types for large-scale development at a later date. At the same time, they are building some rather large nuclear power stations which should be completed in 1961 or 1962. The McCone group was shown the 200,000-kilowatt plants at Voronezh and Byeloyarsk, which are in the initial stages of construction. Mr. McCone was of the opinion that our civilian nuclear power program is considerably more advanced than the Russian program at the present time.

Outside of Russia, there is considerable activity in the nuclear power field in East Germany, Czechoslovakia, Poland, and in Communist China; and other Soviet Bloc countries, such as Hungary, Roumania, and Bulgaria, are also much interested because of limited fuel supplies and little hydroelectric power.[4] Until 1955, when the USSR announced plans to begin some peaceful nuclear sharing with the principal nations of its bloc, those nations had been confined to a limited amount of theoretical research conducted at the universities. With the sharing offer, however, training equipment such as research reactors, cyclotrons, isotope-producing reactors, etc, were delivered to these countries, and at the same time scientists from these countries were given training courses at Soviet institutes and universities. Although progress was slow at the start, it is gradually becoming impressive. East Germany and Czechoslovakia are now building their first nuclear power stations, and there is little doubt that the significance of their nuclear power programs will increase substantially during the next decade.

In East Germany the first 70- to 100-Mw (e) pressurized-water re-

actor fueled with natural and enriched uranium is scheduled to go into operation in 1960. This is to be a pilot plant. After this pilot plant is in operation East Germany has plans to build a network of some 20 nuclear power stations by 1970. Several of these are expected to be in operation by 1965. At present, East Germany needs the help of the Soviet Union in building the first nuclear power plants, but it is looking forward to establishing an independent nuclear program in the future. An intensive program in applied nuclear physics has been under way at East German institutes to supplement the number of advanced students being trained in Russia. A number of new training centers have been established, and research and isotope laboratories have been added in existing universities, technical schools, and certain industrial plants.

Czechoslovakia's Plans

Czechoslovakia also has plans to establish a nuclear power network; indeed, Czech officials think there will be enough nuclear power capacity to meet one-third of the country's electric power needs by 1970. After 1970, all future increases in power generating capacity are to be met by nuclear energy. So far, however, no nuclear power plants have been built. A 150-Mw (e) nuclear plant was started in 1958, and this is scheduled to go into operation in 1960. It is a natural uranium heavy-water reactor being built with Soviet help. With the experience gained on this first nuclear plant, Czech scientists hope to design and build future stations without Soviet help. Like East Germany, Czechoslovakia urgently needs new power sources and, to make maximum use of uranium supplies, it has decided to concentrate on the development of fast-breeder-reactor designs. As in East Germany, an ambitious training and research program is under way. Prague is the focal point for training technicians. There the Institute of Nuclear Physics of the Czechoslovak Academy of Sciences is steadily expanding. Another important training center is the Department of Nuclear Physics at Charles University in Prague, which has a five-year course as well as a number of shorter training programs.

Nuclear power development in Poland is less intense than in East Germany or Czechoslovakia, partly because Poland is less industrialized and, also, because it has a more ample coal supply. However, Poland plans to divert coal supplies to other uses as nuclear power becomes commercially feasible, and plans are to have a 200-Mw-capacity nuclear plant in operation by 1965. Following this, plans are to build a small network of nuclear power stations totaling about 600 Mw. In the meantime Poland will concentrate on increasing applications of radioisotopes and improving the exploitation of her uranium ores. Discoveries of much larger and better quality uranium mines in Poland, coupled with a new joint Polish-Soviet agreement for mining and processing the new ores, is expected to step up this aspect of the industry. Curiously, Poland is unique among the nations of the Soviet Bloc in not depending solely on the Soviet Union for assistance.

In Communist China, so far, little has been done in the development of nuclear power, but there is considerable interest and activity in establishing a base from which to start. Emphasis is placed on improving existing training and research centers and establishing new ones. Research seems to be concentrated at the institutes of Atomic Energy and of Applied Physics of the Chinese Academy of Sciences, both located at Peking, and at Peking University. An entire new university, the Chinese University of Science and Technology, under the supervision of the Academy of Sciences, was also opened in Peking in September, 1958. An experimental test reactor and cyclotron purchased from the Soviet Union are in operation at the Institute of Atomic Energy.

With respect to Hungary, Roumania and Bulgaria, only very limited research in the field of nuclear energy is going on. At the Academy of Sciences' Central Physics Institute near Budapest, a small research reactor purchased from the USSR is in operation. Hungary has limited supplies of coal and oil and virtually no hydroelectric power, consequently needs nuclear power to meet the increasing electricity requirements of a more industrialized future economy; but because of the revolution the nuclear energy program has been delayed.

Japanese Developments

Japan has two nuclear power projects under way: one, a Calder Hall type station to be built by Britain's General Electric Co, and the other, a boiling-water reactor sold by U.S.'s General Electric Co. There is rivalry between the two firms concerning the date of completion of these stations. U.S. General Electric claims that its boiling reactor will go critical late in July, 1961, some two years ahead of the British unit, but the British unit is rated at 159 Mw (e), whereas the American reactor is rated at only 12.5 Mw (e). The latter will be a direct boiling-water reactor with natural and forced-circulation cooling, and will be so designed that later it can be adapted to the dual-cycle system. These two reactors will be the first nuclear power reactors in Japan, and both will be built at Tokai Mura, about 70 miles north of Tokyo. Japan, however, has had research reactors in operation for some time. The cost of the British plant is estimated at $84 million with GEC's contract price set at $56 million; the remainder to be spent in Japan is for electrical equipment and general construction. This improved Calder Hall type reactor will permit charging and discharging of fuel elements while the gas-cooled reactor is in full operation.

Atomic Power in India

In India, interest in the development of nuclear power has been high from the first and much excellent theoretical work in nuclear science has been done, but so far no nuclear power plants have been started. India has, however, decided to build its first nuclear power station with an installed capacity of approximately 250 Mw, and preliminary work on it has already been started. Unlike China, India's coal reserves are rather limited, the proved reserves being about 43,000 million tons, although the probable reserves may be as much as three times as much. This, however, makes the Indian reserves of coal per capita only 1/35th of those in the United States. These reserves, moreover, are concentrated in only about four States; 55 per cent lie in the States of Bengal and Bihar in northeastern India, and some 25 per cent in the State of Madhya Pradesh. The thermal power stations in Bombay and Ahmedabad receive their coal from Bengal and Bihar over a distance of 1500 miles, while Delhi receives its coal from the same area over a distance of 800 miles.[5] This pushes up the price of coal to two or three times its value at the mines, resulting in a corresponding increase in the cost of power. As explained by Dr. Homi J. Bhabha in his recent statement before the International Atomic Energy Agency in Vienna, "What is equally important, however, is the capital investment required for the transport system, to transport coal. This point is usually ignored."

Studies made in India showed that where good quality of coal has to be hauled over a distance of about 700 miles, an investment in railway equipment of some $132 per kw is required — nearly 50 per cent of the cost of small-sized thermal stations such as might be erected in several parts of India. It is for this reason, among others, that India is intent on developing nuclear power. The capital investment required for nuclear power is quite comparable with the capital investment required for hydro projects in India and not much higher than the investment required for thermal stations remote from the coal fields. Bearing in mind the limited coal reserves and hydro power of the country, which are only enough to see India through for the next 10 or 20 years, it is clear that an important beginning with nuclear power has to be made now, so that it may be in a position to take on a major

CIVILIAN NUCLEAR POWER REACTORS IN THE UNITED STATES

(A) Large-scale Commercial Power Plants

Name and/or Owner	Location	Principal Contractor**	Type	Power (Kilowatts) Electrical (Net)	Power (Kilowatts) Thermal	Start-Up
Operable						
Shippingport Atomic Pwr. Sta. (AEC & Duquesne Light Co)	Shippingport, Pa.	Westinghouse	Pressurized water	60,000	231,000	1957
Being Built:						
Dresden Nuclear Power Station * (Commonwealth Edison Co)	Morris, Ill.	General Elec.	Boiling water	180,000	626,000	1959
Consolidated Edison Thorium Reactor *	Indian Point, N. Y.	B & W	Pressurized water	255,000	585,000	1961
Enrico Fermi Atomic Power Plant (Power Reactor Development Co)	Lagoona Beach, Mich.	Owner	Fast breeder	90,000	300,000	1960
Yankee Atomic Electric Co	Rowe, Mass.	Westinghouse	Pressurized water	110,000	392,000	1960
AEC & Rural Coöperative Power Association	Elk River, Minn.	AC	Boiling water	22,000	73,000	1961
Hallam Nuclear Power Facility (AEC & Consumers Public Power District)	Hallam, Nebr.	AI	Sodium graphite	75,000	240,000	1962
Planned:						
AEC & City of Piqua, Ohio	Piqua, Ohio	AI	Organic moderated	11,400	45,500	1961
Northern States Power Co Pathfinder Plant	Sioux Falls, S. D.	AC	Boiling water	62,000	203,000	1962
Carolinas–Virginia Nuclear Power Associates, Inc	Parr, S. C.	Westinghouse	Pressure tube heavy water	17,000	60,500	1962
Humboldt Bay Project * (Pacific Gas and Electric Co)	Humboldt Bay, Calif.	General Elec.	Boiling water	50,000	163,000	1962
Consumers Power Co *	Big Rock Point, Mich.	General Elec.	Boiling water	50,000		1962
East Central and Florida West Coast Nuclear Groups	Florida	GNE	Gas cooled, heavy water moderated	50,000	150,000	1963
Philadelphia Electric Co	Peach Bottom, Pa.	GDC	Gas cooled, graphite moderated	28,500	92,000	1963

(B) Nuclear Reactor Experiments

Name (all owned by AEC except as noted.)	Desig-nation	Location	Princ. Contrac-tor**	Type	Power (Kilowatts) Electrical (Net)	Power (Kilowatts) Thermal	Start-Up
Operated, later dismantled:							
Boiling Reactor Experiment No. 1	BORAX–1	NRTS, Idaho	ANL	Boiling water	No elec.	1,400	1953
Homogeneous Reactor Experiment No. 1	HRE–1	Oak Ridge, Tenn.	ORNL	Aqueous homogeneous solution (UO_2SO_4)	140	1,000	1952
Los Alamos Power Reactor Experiment No. 1	LAPRE–1	Los Alamos, N. M.	LASL	Aqueous homogeneous (Phosphoric acid)	No elec.	2,000	1956
Boiling Reactor Experiments	BORAX–2, 3, 4	NRTS, Idaho	ANL	Boiling water	2,000	15,500	1954
Operable:							
Experimental Breeder Reactor No. 1	EBR–1	NRTS, Idaho	ANL	Fast breeder	150	1,400	1951
Experimental Boiling-Water Reactor	EBWR	Lemont, Ill.	ANL	Boiling water	4,500	100,000	1956
Vallecitos Boiling-Water Reactor (General Electric Co.)* & Pacific Gas and Elec. Co)	VBWR	Pleasanton, Calif.	GE	Boiling water	5,000	30,000	1957
Sodium-Reactor Experiment (AEC & Southern Calif. Edison Co)	SRE	Santa Susana, Calif.	AI	Sodium graphite	6,000	20,000	1957
Organic-Moderated Reactor Experiment	OMRE	NRTS, Idaho	AI	Organic moderated	No elec.	5,000 to 15,000	1957
Homogeneous-Reactor Experiment No. 2	HRE–2	Oak Ridge, Tenn.	ORNL	Aqueous homogeneous solution (UO_2SO_4)	Negligible	5,220	1957
Los Alamos Power Reactor Experiment No. 2	LAPRE–2	Los Alamos, N. M.	LASL	Aqueous homogeneous (Phosphoric acid)	No elec.	1,000	1959
Being Built:							
Experimental Breeder-Reactor No. 2	EBR–2	NRTS, Idaho	ANL	Fast breeder	16,500	62,500	1961
Los Alamos Molten Plutonium Reactor Experiment No. 1	LAMPRE–1	Los Alamos, N. M.	LASL	Fast molten plutonium	No elec.	1,000	1959
Planned:							
Pennsylvania Electric Co *		Saxton, Pa.	West	Pressurized water	5,000		1961
Boiling-Reactor Experiment No. 5	BORAX–5	NRTS, Idaho	ANL	Boiling water	2,000	20,000	1960
High-Temperature Gas-Cooled Reactor Experiment	TURRET	Los Alamos, N. M.	LASL	Gas cooled	No elec.	3,000	1961
Experimental Prototype Gas-Cooled Reactor	EPGCR	Oak Ridge, Tenn.	KE-ACF	Gas cooled graphite moderated	24,000	84,000	1962
Experimental Organic-Cooled Reactor	EOCR	NRTS, Idaho		Organic	No elec.	25,000	

* Privately owned.

** ANL, Argonne National Lab.; ORNL, Oak Ridge Nat. Lab.; LASL, Los Alamos Scientific Lab.; GE, General Electric Co; AI, Atomics International; West.; Westinghouse Electric Corp; KE-ACF, Kaiser-American Car & Foundry; GNE, General Nuclear Eng., GDC, General Dynamics Corp

part of the increase in load after 15 years.

Nuclear Power in the United States

In the United States, the only large nuclear power station actually in operation at the present time is the 60,000-kw (e) pressurized-water reactor plant of the Duquesne Light Co at Shippingport, Pa. Last year, this station completed its first 3½ yrs of operation on the initial charge of uranium, and in that period it produced about 350 million kwh of electricity. Although Shippingport delivers power to the Duquesne Light system, it is actually an experimental plant built under the AEC's Power Reactor Demonstration program. The plant has operated at full power for over 5000 hr. In addition to carrying out an extensive and varied test program, the plant has demonstrated its ability to perform well both as a base-load or peak-load station. PWR's second core may produce 150,000 kw (e).

From a commercial standpoint, the most important nuclear power station in the United States is the Dresden Station of the Commonwealth Edison Co, 50 miles from Chicago, Ill. This 180,000-kw (e) boiling-water reactor plant is not only the largest all-nuclear power station to be completed, but it is also the first full-scale privately-financed plant. Designed and built by the General Electric Co, Dresden is the first boiling-water plant to use the dual cycle. The station was virtually complete early in October, 1959, fully six months ahead of schedule. Dresden Station is expected to go into full power operation by mid-1960.

A list of the civilian power reactors in operation or under construction in the United States is given in the accompanying tabulation. The first group (A), which includes Shippingport and Dresden Stations, are all strictly power reactors intended to provide electricity for commercial purposes. Most of these plants are being built under the AEC Power Reactor Demonstration Program. Only Indian Point, Dresden, Humboldt Bay, and the Big Rock Point plant of Consumers Power Co are privately financed.

The number of boiling-water and pressurized-water plants are about equally divided. The boiling-water reactor is relatively new compared to the pressurized-water reactor, but it appears to be coming into considerable favor. The nuclear stations built by Westinghouse Electric Corp, thus far, have all been of the pressurized-water type. The General Electric Co, on the other hand, favors the boiling-water reactor and feels that this type reactor has the best chance of producing competitive power in the near future. Westinghouse does not deem it wise to concentrate on promoting any one type of reactor. Westinghouse engineers are of the opinion that as sizes of reactors increase and as operating temperatures and pressures go higher, the differences between the pressurized-water and boiling-water reactors will disappear; *i.e.*, that the systems will merge. Consequently, Westinghouse has abandoned the use of the terms "pressurized" and "boiling" and is offering reactors of both kinds, calling them "closed cycle" and "direct cycle," respectively.

The nuclear reactors listed under Group B of the tabulation are nearly all experimental plants owned by the Atomic Energy Commission. These include the first boiling-water plants, (EBWR, BORAX-2, 3, and 4), the first fast breeder (EBR-I), and the Sodium-Reactor Experiment (SRE). The purpose of these plants is to demonstrate their technical feasibility and to produce data and information useful in evaluating the economic possibilities of these various type systems. In some of these plants the electrical energy generated is supplied to commercial electric utility networks, but the primary purpose remains experimental.

As indicated at the beginning of this review of nuclear power development, one of the disadvantages of present nuclear power systems is the relatively low-temperature steam available from both pressurized- and boiling-water reactors. There has, therefore, been considerable effort expended in the development of effective methods of producing nuclear superheat. Commercial interest in nuclear superheat is evidenced by the vigorous response to the AEC's call for bids to do engineering work on promising concepts and materials for advanced reactors producing superheated steam; eight proposals were submitted by firms in the United States.

An encouraging recent development was the production by the Sodium-Reactor Experiment of steam at 1000 F, believed to be the highest-temperature steam ever produced in a nuclear reactor. This took place on May 22, 1959. With this reactor operating at 6.9 Mw (th), an average steam temperature of 900 F was maintained for eight days. This, of course, was superheated steam.

There are indications also of high achievable operating temperatures from gas-cooled reactors. Recently the Induction Simulated Reactor Facility, operated jointly by the AEC and the Bureau of Mines at Morgantown, W. Va., passed its 50th hour of operation at helium temperatures above 2200 F, including about 20 hours at 2300 F. An indicated helium gas temperature of 2500 F was maintained for about an hour.[6]

These experiences at the SRE and at Morgantown give evidence that we are on the way to removing one of the previous limitations in reactor technology, namely temperature limitations which led to low thermal efficiency.

At present three plants are being designed to use nuclear superheat. First is the Pathfinder Plant of Northern States Power Co. During the year the AEC announced completion of the contract modifications whereby Northern States Power Co is authorized to use the two-region superheating core designed by Allis-Chalmers Co, for the 66,000-kw boiling reactor to be built at Sioux Falls, S. D. Argonne National Laboratory also is progressing with the design of BORAX-5 for the use of superheat, and AEC is evaluating a preliminary design submitted by General Nuclear Engineering Corp on BONUS (BOiling NUclear Superheat), the 15,000-kw plant being developed for Puerto Rico.

Although the water-cooled reactor appears to offer the most favorable prospects for nuclear power at the present time, there is considerable interest in the long-range development of the high-temperature, gas-cooled reactor. Two types are under serious consideration: the gas-cooled, heavy-water-moderated 50,000-kw plant of the East Central and Florida West Coast nuclear groups, being designed by General Nuclear Engineering Corp, and the gas-cooled, graphite-moderated reactor of the Philadelphia Electric Co, being designed by General Dynamics Corp. Actually, the latter project is sponsored by Philadelphia Electric and 51 other utility companies. This plant is to be designed to produce 40,000 kw of electricity from steam at 1000 F and 1450 psi, using graphite-canned fuel elements. Helium probably will be used as the coolant With its initial loading of metallic-clad fuel elements, the plant will produce about 30,000 kw from steam at 850 F and 850 psi. The purpose of this plant is to serve as a prototype for a much larger plant later on. The AEC proposal under which this plant is being constructed states that studies and cost estimates for a large size high-temperature, gas-cooled-reactor power plant, with an electrical output of 325,000 kw, indicate that such a plant would produce power competitive in cost with conventional power in many areas of the United States. There, of course, would be high fuel cost areas.

A significant item in the cost of nuclear power stations using water-cooled reactors is the cost of the containment vessel provided to confine the radioactive material that would be released in the event of a major nuclear accident. These vessels have had to be very large in order to minimize the pressure rise due to the sudden release of steam. During the year a significant contribution was made to the solution of the containment problem by the development of what is called "pressure suppression containment." The consulting engi-

neering firm of Sargent & Lundy of Chicago carried out a very interesting series of experiments during the summer of 1959[7] to determine how effective the use of cold water in a containment vessel was in preventing the pressure rise due to the sudden release of high-pressure steam and water. In these tests it was demonstrated that the energy release was so effectively absorbed by the water that the pressure rise was limited to about 5 psi, whereas, without the water, the calculated pressure was well over 100 psi. The practical adoption of this method of containment would greatly reduce the cost of containment, and since the vessels can be made much smaller, it will be possible to place them underground.

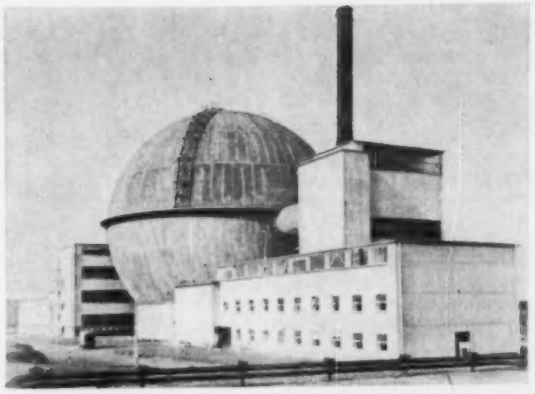


Fig. 2 The fast breeder reactor at Dounreay, Scotland, which went critical for the first time in November, 1959. This photo shows the buildings housing the heat exchangers and the great globe containing the reactor

Nuclear Power Economics

A significant announcement with respect to nuclear power costs was that made by Westinghouse Electric Corp in September offering to guarantee nuclear power costs to the utility companies for certain types of nuclear plants, *i.e.*, a combination plant using a nuclear reactor with a fossil fuel superheater, and a 330,000-kw closed-cycle plant.[8] The combination plant would be a 225,000-kw plant using a direct-cycle boiling-water reactor producing steam at 1800 psi, which would be superheated in a fossil-fuel-fired superheater to 1000 F. This plant would produce power at a total cost of 7.3 mills per kwh. Westinghouse offers to build this plant for completion in four years for a total of $49.5 million, including $4.5 for research and development. The 330,000-kw closed-cycle plant would also produce power at 7.3 mills per kwh. These figures include capital cost, fuel, fixed charges, and operation and maintenance costs. This plant, according to Westinghouse engineers, can be built at a cost of $206 per kw, installed.

These power costs are lower than the costs arrived at in an AEC study of the status and prospects of the eight major reactor concepts under development in the United States. These studies show that pressurized and boiling-water reactors, built with current know-how, could deliver electricity at 8.8 mills per kwh in the most favorable sizes closest to 300 Mw (e). Except for the organic-moderated concept, the water-cooled and moderated reactors made the best showing in these economic analyses. It was estimated that a 300-Mw organic-moderated reactor could produce 7.1 mill electricity, but this cost is based on fuel-element technology not yet demonstrated. Other cost estimates ranged from 9 to 10 mills for a 400-Mw (e) heavy-water reactor to 14.3 mills for a fast breeder built by 1961.

The AEC analysis shows that the boiling-water reactor with integral superheat has the best chance of achieving economic power production in high fuel cost areas in the United States by 1965. At present, the pressurized-water plant has a slight edge over the boiling reactor, but over the next few years, the better potential for reducing costs appear to lie with the BWR or with a hybrid BWR–PWR, which incorporates the best features of both, including integral superheat. Making conservative allowances for technological advances, for reductions in construction and fuel fabrication costs, and for a decrease of about 25 per cent in the cost of U^{235}, AEC officials estimate that light-water reactors may be able to deliver electricity for less than 6 mills per kwh by AEC's deadline for achieving economic nuclear power in the United States — 1968. In terms of meeting this political, rather than technological, goal, they rate heavy-water, sodium-graphite, and organic-moderated reactors behind the light-water concepts and, even farther back, gas-cooled reactors. The last concept, it is felt, will continue to face the obstacle of high capital costs which has held it back in the United States until only recently. AEC studies show that homogeneous reactors generally do not give promise of producing low-cost power when compared to the other reactor types. Accordingly the AEC is now closing out studies of the liquid-metal fuel reactor (LMFR) and the fused salt reactors, and is also cutting back to some extent on the aqueous-homogeneous work.

A development of considerable importance for the economic potential of some reactors (helium-cooled, graphite-moderated) is the recent series of test irradiations of uranium carbide fuel specimens in the Materials Testing Reactor. Three irradiations were completed for 500, 1400, and 6000 megawatt days per ton, respectively, at central temperatures up to 1346 F. The greatest volume increase noted was only 2 per cent. Two more irradiations are now in progress, to extend for 10,000 and 15,000 Mwd per ton, respectively. This fuel has thermal conductivity comparable with metallic uranium, and stability against radiation damage expected to be comparable with that of uranium oxide.[7]

Conclusion

This admittedly sketchy review of nuclear power development provides obvious evidence of the tremendous advance which characterizes virtually every aspect of this new energy source in all the major nations of the world. There is definite indication that we are coming close to what we call "economic nuclear power" by the use of certain types of reactors. More attention is being given to fewer reactor concepts. In the early days of civilian power development there was little assurance that any concept then under study would be able to produce economic power, breed effectively, or otherwise meet objectives. For that reason the AEC deemed it unwise to overlook any concept which offered reasonable promise. Thus, to improve the probability of success it was necessary to work on a large number of varied concepts; at one time the AEC did conceptual analysis on more than 100 different reactor ideas. Recently, however, it has become apparent that certain reactor concepts have a better chance than others of at least realizing short-term objectives, and the time has come where we can be more selective in deciding which reactor types to carry forward into extensive and expensive hardware development. The water-cooled and moderated reactors seem especially attractive.

As far as the world picture is concerned, the greatest nuclear development that has taken place up to now has been in the United States, Great Britain, and the USSR. To date, 1875 Mw have been ordered by the Electricity Boards in England, and Calder Hall and Chapelcross (which are Atomic Energy Authority plants) will contribute about 300 Mw more. In addition, preparations are being made to order two more large-output stations. The latest figures in the U.S. program total about 1000 Mw by 1963. Accurate figures on Russia's nuclear development are not available but according to a recent statement by Professor Emelyanov, head of Russia's central agency for atomic energy development, the USSR expects to have an installed nuclear

electrical generating capacity of 2000 to 2500 Mw by 1964 or 1965. Euratom forecasts something under 3000 Mw by 1966.

The changing picture of world fuel supply; the large-scale switch of industry from coal to oil, resulting in a temporary surplus of coal in some countries, has brought about some recession in the nuclear power program, but this is expected to have little effect on the long-range outlook. Although many factors are involved in nuclear power costs, there is one factor favoring lower nuclear power costs that seems reasonably certain. Uranium prices are confidently predicted by experts to fall from the current level of $12 a pound to below $8 a pound in the middle 1960s, and this could result in a fall of up to 10 per cent in over-all nuclear power costs. There are also some possible bonuses such as increased burnup and load factors higher than assumed. If these favorable factors are combined with the fact that electricity demands of the world are still rising exponentially with a doubling time of ten years, there is every reason for believing that nuclear power development will go forward at a much more rapid rate than it has during the brief period of its infancy.

REFERENCES

1. Costs of Nuclear Power, Office of Operating Analysis and Forecasting, AEC, TID-8506, July, 1959
2. United Kingdom Atomic Energy Authority, Fifth Annual Report 1958–59, Her Majesty's Stationery Office, London, England
3. Five Reactors Proposed to Euratom for '63 Completion, *Nucleonics* 17:7-p 19, July, 1959
4. Anne M. Jonas, Atomic Energy in Soviet Bloc Nations, *Bulletin of the Atomic Scientists*, 15:9-p 397, Nov, 1959
5. Statement of Dr. Homi J. Bhabha, *International Atomic Energy Agency Bulletin*, special number, p 6, Nov, 1959
6. Ulysses Stabler, Recent Development in the Civilian Power Reactor Program, address before American Nuclear Soc, Gatlinburg, Tenn, June 15, 1959
7. Sargent & Lundy, Preliminary Report 1959 Containment Tests, Oct 13, 1959
8. Guaranteed-Price Atomic Power Offered by Westinghouse, ATOMICS sect, POWER ENGINEERING, Dec, 1959

New Nuclear Literature

AMONG the publications recently issued by the U. S. Atomic Energy Commission, one that should be of special interest to industrial power engineers and engineers associated with small utility companies or cooperatives is Task Force Evaluation Report — Small-sized Nuclear Power Plant Program (TID-8508). This 59-page report compares the capabilities and status of the boiling-water, pressurized-water, and organic-moderated reactor concepts to the end of selecting a type suitable for immediate construction as a small-sized (500 to 40,000 kw, electrical) civilian nuclear power station. Estimated construction costs for each concept are shown, as are estimated conventional plant costs in high-cost fuel areas. The reactor concept recommended for construction is a pressurized-water, light water-cooled and -moderated unit using slightly enriched UO_2 as fuel. It would have a fossil fuel-fired superheater and a standard "handbook" turbo-generator for a gross capacity of 22,000 kw. . . . The comparison between the costs of the 22-Mw conventional plant and the 22-Mw nuclear plant is interesting. Based on a capacity factor of 60 per cent, the net output at 20.5 Mw, for both type plants, is 107.6 million kwh per yr. With fixed charges at 5.1 per cent for the conventional plant and 7 per cent for the nuclear plant and the same annual cost for both plants, the total generating cost for the conventional plant is estimated at 10.9 mills per kwh, and 16.9 mills per kwh for the nuclear plant. Operation and maintenance for the nuclear plant was assumed to be 150 per cent of that for the conventional plant. In presenting these cost figures the report recognizes the fact that the nuclear plant total generating cost possibly may be reduced without requiring any change in technology. It is believed that the small PWR has excellent prospects for design and capital cost improvements and reductions in operating costs to the point where total fuel costs plus all other operating charges would be less than fuel and operating charges for a conventional plant in the same location. TID-8508 is available from the Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C., for $1.75 a copy. * * * Another publication that was recently issued by the Atomic Energy Commission is TID-8200, entitled *Nuclear Reactors Built, Building, or Planned in The United States as of June 30, 1959.* This list includes the following types of reactors: Civilian power and propulsion reactors; Other civilian reactors; Military propulsion, power and test reactors; Production reactors and Reactors for export. The booklet also includes a list of critical assembly facility abbreviations. Copies of this 32-page publication may be obtained direct from Technical Information Service Extension, U. S. Atomic Energy Commission, P.O. Box 62, Oak Ridge, Tenn. * * * The growth of nuclear reactor design and construction is proceeding at such a rate that it is difficult for those interested to be properly informed concerning the current status of the field. In view of this situation, the Executive Committee of the Nuclear Engineering Division of the American Society of Mechanical Engineers established the Technical Data Committee, whose principal responsibility is the compilation of pertinent reactor information and its presentation in a standardized manner for publication periodically.

As a result of the work of this Committee, two volumes of nuclear plant data have just been published by the ASME and the McGraw-Hill Book Company. Volume I, the 1959 edition of *Power Reactors*, presents information about the type of reactor plants and their experimental prototypes that are designed to produce electric power. It contains both general information and specific technical data, presented uniformly for each plant. Although all the items on the data sheet may not apply to each reactor, it is believed that this standardization will be helpful in quickly locating the desired information. The other volume, Volume II of Nuclear Plant Data, entitled *Research and Test Reactors*, is similar in form and organization to Volume I but deals with research and test reactors.

The information presented in both of these volumes is the latest power-reactor data available to the Committee at the time of publication. It was obtained from replies to questionnaires sent to cover all known power and research reactors in the world, including prototype power reactor projects. Some publicly announced power projects did not have information available at the time it was requested and are therefore unreported. This missing data, however, will be published in subsequent editions of these volumes as it becomes available. Completeness of data has been an objective, and to make it useful a schematic flow diagram for each power reactor system has been included wherever possible.

To obtain the data, inquiries were sent to responsible persons associated with every known power and research reactor project in the world. The response to these requests is reported to have been excellent and this is evidenced by the fact that few known reactor projects are not included in these volumes. Volume II on research reactors contains information on 53 research reactors located in the United States and 42 reactors in Canada, South America, Western Europe, Asia, and Australia. Power output for these reactors ranges from zero watts to over 175,000 kw, with reactor facility costs from a few thousand dollars to over $50 million. As an example of the up-to-date character of the data, some of the data for the Savannah River 305 Test Pile were declassified as recently as August 19, 1958, so they could be published in this volume.

Both volumes are 8½ by 11 in., with hard covers. Volume I has 128 pages; Volume II, 297 pages. Both Volumes are available from the McGraw-Hill Book Co, Inc, 330 W. 42nd St, New York, N. Y. at these prices: Vol. I, $3.75; Vol. II, $7.50.

AI's extensive field laboratory is located in California's Santa Susana Mountains. *Woodcut by Edward Kysar.*

How can A.I. facilities help you plan a Nuclear Program?

In the picturesque Santa Susana mountains near Los Angeles, Atomics International has built an extensive field laboratory for research, engineering and testing in the nuclear sciences. Here, and at a headquarters complex in the valley below, men who pioneered the creative uses of atomic energy are applying their experience to develop advanced nuclear reactors and associated equipment.

Fourteen years of experience in developing various types of reactors for the Atomic Energy Commission and other organizations have given the men of Atomics International a collective background unparalleled in the industry. The facilities at their disposal are among the most sophisticated and extensive in the world.

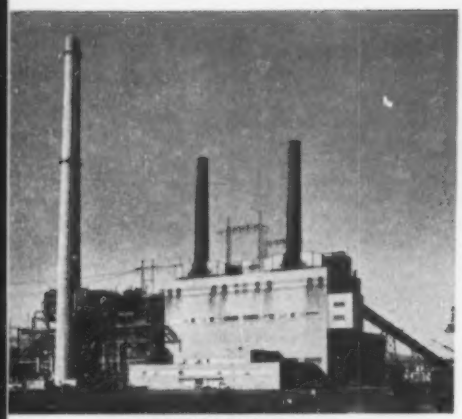
Results of AI's work have been demonstrated in projects for the AEC which include the Organic Moderated Reactor Experiment at the National Reactor Testing Station in Idaho and the Sodium Reactor Experiment at the company's field laboratory. Additionally, AI built and is operating SNAP II, a 220 pound prototype reactor to produce three kilowatts of electricity for space vehicles.

Atomics International is also building large power reactors for electric utilities in Ohio and Nebraska under AEC programs. Studies are underway for other power reactors in the United States and Europe. Research reactors have been built by AI for Denmark, Germany, Italy, Japan, Puerto Rico and several sites in the United States.

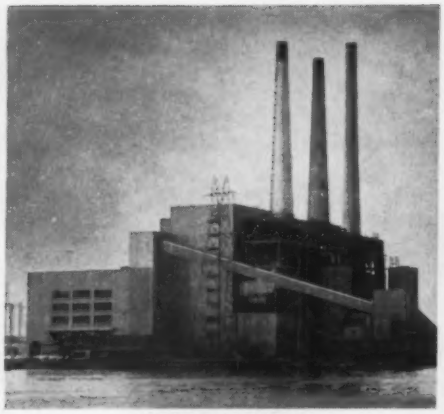
For details contact: ATOMICS INTERNATIONAL, Canoga Park, California, U.S.A. Cable address: ATOMICS.

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.
PIONEERS IN THE CREATIVE USE OF THE ATOM

Other offices in: Washington, D.C., U.S.A.; Geneva, Switzerland. Affiliated with: INTERATOM, Bensberg/Cologne, Federal Republic of Germany and DYNATOM, Paris, France.



MUSKINGUM RIVER
9161 Btu/kwhr Ohio Power Co.
on the American Electric Power System
Two B&W Pressure-Fired Open-Pass Boilers and two Pressure-Fired Radiant Boilers



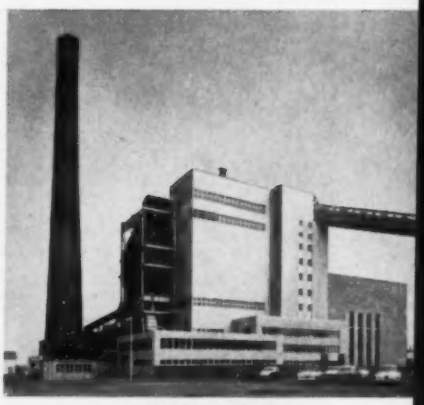
RIVER ROUGE
9160 Btu/kwhr
Detroit Edison Co.
One B&W Radiant Boiler
Firing 10% Blast Furnace Gas and 90% Coal

CLIFTY CREEK
9130 Btu/kwhr
Indiana-Kentucky Electric Corporation*
Six B&W Pressure-Fired Open-Pass Boilers

ALLEN
9178 Btu/kwhr
Duke Power Co.

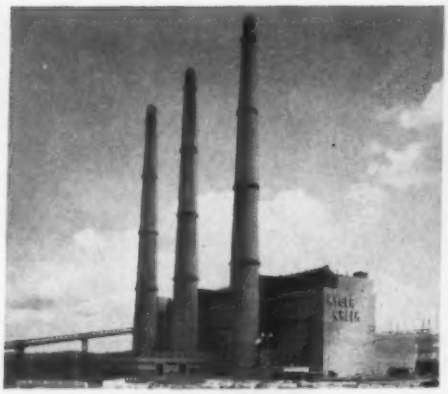
McMEEKIN
9093 Btu/kwhr
Part year, more than 6 months
South Carolina Electric and Gas Co.

KANAWHA RIVER
9143 Btu/kwhr
Appalachian Power Co.
on the American Electric Power System
Two B&W Pressure-Fired Radiant Boilers

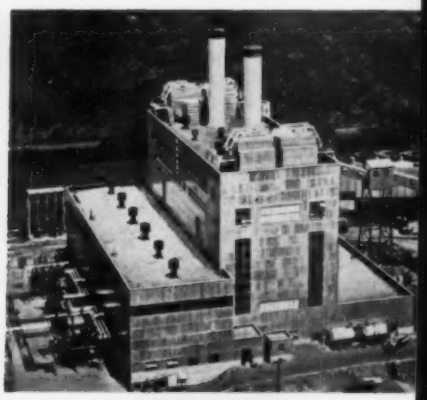


BAY SHORE
9233 Btu/kwhr
Toledo Edison Co.
One B&W Radiant Boiler

TANNERS CREEK
9209 Btu/kwhr
Indiana & Michigan Electric Co.
on the American Electric Power System
Three B&W Pressure-Fired Radiant Boilers



KYGER CREEK
9166 Btu/kwhr
Ohio Valley Electric Corporation*
Five B&W Pressure-Fired Open-Pass Boilers



SHAWVILLE
9163 Btu/kwhr
Pennsylvania Electric Co.
Two B&W Radiant Boilers

FOR FIFTH CONSECUTIVE YEAR

B&W's Engineering Leadership Proved in Nation's Most Efficient Power Plants

It's the same story, year after year; most of the stations reported "best heat rate stations" by the Federal Power Commission are equipped with B&W Steam Generators. In the past five years . . .

1958 — 8 out of 10 "most efficient"
1957 — 8 out of 10 "most efficient"
1956 — 9 out of 10 "most efficient"
1955 — 7 out of 10 "most efficient"
1954 — 7 out of 10 "most efficient"

The "why" of this leadership is a pace setting research and development program that has given the power industry such innovations as gas tempering, the Universal Pressure Boiler, pressure firing, the Cyclone Furnace, and the Cyclone Steam Separator that makes natural circulation practicable in the highest pressure subcritical boilers.

B&W works closely with the Electric Utility industry helping to meet, often anticipating, their needs. In this way electric utilities and their suppliers can continue to fulfill their vital role in American growth. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

G-959-CS

***Ohio Valley Electric Corporation and its subsidiary, Indiana-Kentucky Electric Corporation, sponsored by these companies:**

Appalachian Power Company (a) • The Cincinnati Gas & Electric Company • Columbus and Southern Ohio Electric Company • The Dayton Power and Light Company • Indiana & Michigan Electric Company (a) • Kentucky Utilities Company • Louisville Gas and Electric Company • Monongahela Power Company (b) • Ohio Edison Company • Ohio Power Company (a) • Pennsylvania Power Company (c) • The Potomac Edison Company (b) • Southern Indiana Gas and Electric Company • The Toledo Edison Company • West Penn Power Company (b)

(a) Subsidiary of American Electric Power Co. (b) Subsidiary of The West Penn Electric Co. (c) Subsidiary of Ohio Edison Co.

Here's a vertical turbine with

TERRY SOLID WHEEL

and all its advantages

When it comes to judging a turbine's ability to deliver in vertical service, ratings tell only half the story. It's the Terry construction refinements that give you assurance of long-range operational economy: Thrust bearing designed to absorb external pump thrusts ... carbon ring glands specially made for vertical operation ... casings and bearing housings split vertically for easy accessibility.

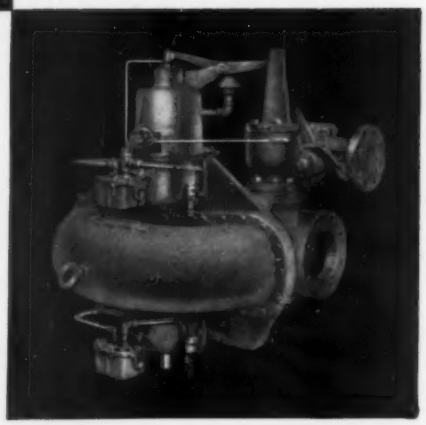
But most important, the Terry vertical turbine has an *almost* indestructible rotor. A single forging of special composition steel, it has no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

If your application demands a vertical turbine, specify Terry solid wheel. Available in capacities from 5 to 300 horsepower. And remember, the extra durability built into these vertical turbines is typical of every turbine in the complete Terry line.

For further information, send for a copy of bulletin S-137.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY



For more data circle 531 on Post Card

RIC-WIL 50th Anniversary

1910
1911
1912
1913
1914
1915
1916

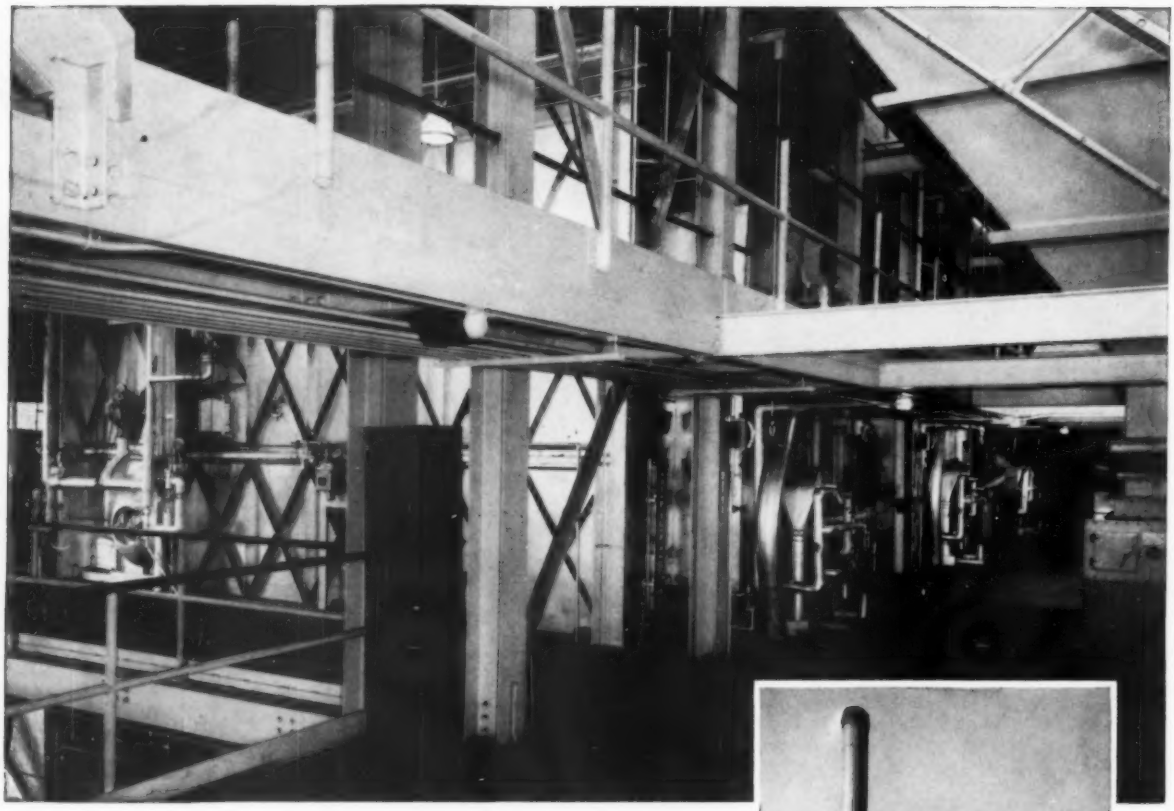
1954
1955
1956
1957
1958
1959
1960

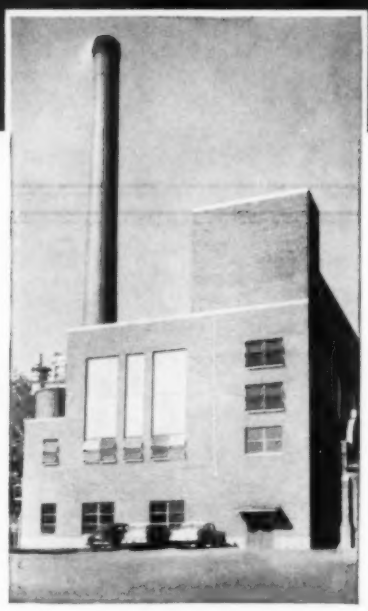
Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

RIC-WIL PREFABRICATED INSULATED PIPING SYSTEMS

CENTRAL OFFICE: RIC-WIL INCORPORATED, BARBERTON, OHIO
WESTERN STATES: WESTERN RIC-WIL COMPANY, NEWARK, CALIF.
IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED

The year 1960 marks fifty years of service by Ric-wiL. Ric-wiL prefabricated and insulated distribution piping systems have been installed worldwide . . . truly, "The sun never sets on Ric-wiL installations". The quality of Ric-wiL prefabricated systems is proven by *many* millions of linear feet of piping . . . installed in every facet of industry, municipalities, colleges and universities and government projects throughout the world. Our aim for the next 50 years . . . continued leadership in underground and overhead prefabricated, insulated piping systems . . .





FIELD REPORT: ESSEX COUNTY HOSPITAL

3 Union steam generators post 86.46% efficiency

75 buildings spread over 553 acres . . . nearly 4000 patients and 1300 employees . . . briefly, that's the physical size of New Jersey's Essex County Hospital Development.

Consisting of two complete divisions — Overbrook Hospital and the Tubercular Sanatorium — the institution relies on three Union Type VO Steam Generators as its sole source of heat and power. Steam is dependably produced to drive a pair of 1000 KW turbine generators, to heat all buildings (some are a mile and a half away), to power the hot water circulating pumps, and to meet cooking, water treatment and deaeration requirements.

With unit capacities of 50,000 lbs./hr. at 300 psig and 460°F, these 2-drum boilers tested out at 86.46% efficiency.

Across the nation, Union Steam Generators are providing dependable, low-cost steam for industrial, institutional and public power plants. Long engineering experience, skilled shopmanship and traditional Union quality are the unwritten specifications that assure their top performance.

FULL INFORMATION on the many types and sizes of Union Steam Generators is contained in illustrated Catalog GB-958. Write for your copy.

UNION

UNION IRON WORKS

ERIE, PENNSYLVANIA

For more data circle 533 on Post Card

U. P. GENERATING COMPANY FOUND A WAY TO BE SURE
OF CHOOSING THE RIGHT TURBINE OIL

They selected NONPAREIL —the only oil with life-of-turbine guarantee

Situation: In 1955, Upper Peninsula Generating Company installed a 22,000 kw General Electric turbine in its Presque Isle station. When lubricant for this turbine was chosen, U. P. management elected to install an oil with a life-of-turbine guarantee—NONPAREIL.

But that wasn't all plant management received when the decision was made to buy NONPAREIL Turbine Oil. In addition, Duane Johnson, Standard Oil lubrication specialist located in Marquette, made a complete lubrication survey of the entire plant. He provided technical service on lubrication during construction and after operations started.

What has happened: In the four years since installation, the turbine has performed satisfactorily without any lubrication difficulty. In a routine inspection a year after installation, the bearings proved to be in excellent condition. Periodically samples of the oil have been removed for analysis at Standard Oil's Whiting laboratory. The oil remains in its original excellent condition.

What you can do: Get this life-of-turbine guarantee on the turbine oil you install by specifying NONPAREIL. Call the lubrication specialist in the Standard Oil office near you anywhere in the 15 Midwest or Rocky Mountain states. Or contact **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

You expect more from STANDARD *and you get it!*

Standard Oil lubrication specialist Duane Johnson (left) and station chief engineer Charles York, inspect 22,000 kw G-E turbine at Presque Isle station. On lubrication jobs of this kind Duane Johnson is well qualified to provide technical service. He has an engineering degree from the Michigan College of Mining and Technology plus 10 years' experience with Standard in this work. He has also completed Standard's Sales Engineering School.

Quick facts about
NONPAREIL
TURBINE OIL

- Will not permit formation of harmful acids
- Will not permit formation of sludge or oil varnish
- Will maintain good demulsibility or water-separating characteristics
- Has high resistance to foaming
- Contains adequate rust inhibitor

THE WESTERN PRECIPITATION

"Transistomatic" CONTROL

BY FAR, the Industry's Most Advanced Precipitator Control...

and carries a Lifetime Guarantee!

In the electrostatic precipitation of dust, fume and fly ash, no installation is completely modern without *automatic* control to maintain optimum Precipitator efficiency as the characteristics of the gas stream fluctuate. Compared with manual control, automatic control is not only more sensitive and more efficient, but actually costs less because of the vital savings it makes in labor and operating costs . . . *savings so important that no profit-minded operator will want to be without them.*

But the important point to remember is this—

Although many manufacturers of precipitation equipment offer units for precipitator automation, no other unit is equal to the "Transistomatic" Control for foolproof simplicity, rugged dependability or control accuracy!

These are not idle claims. They can be easily verified by making your own comparison . . .

A DESCRIPTIVE BOOKLET

that gives further information will gladly be sent on request. Write, wire or phone for your free copy!

Compare ACCURACY! **The "Transistomatic" does not base its "sensing" action on spark *frequency* alone—or spark *intensity* alone. Instead, it continuously integrates BOTH frequency and intensity to establish an overall "power value" that provides a new standard of control accuracy!**

Compare DEPENDABILITY! **The "Transistomatic" unit contains no parts of any kind requiring regular replacement. Moreover, the entire unit is completely sealed—moisture-proof and watertight.**

Compare GUARANTEES! **The "Transistomatic" is so foolproof and trouble-free it carries a *lifetime guarantee!***

BEFORE YOU BUY ANY automatic precipitator control, be sure to get the complete "Transistomatic" story. A folder is available giving additional data. Or see your nearest Western Precipitation representative for further details!

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PRECIPITATION
CORPORATION

Engineers and Contractors of Equipment for Collection of Suspended Material from Gases . . . and Equipment for the Process Industries

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Precipitation Company of Canada Ltd., 8285 Mountain Sights Avenue, Montreal 9

For more data circle 535 on Post Card

Why Every Steam Heated Unit Needs its Own Steam Trap

. . . the theory, practice and proof of "unit trapping" for top temperatures

Using an individual trap for each steam heated unit, including each separate coil, chest or chamber of a machine—pays off for the user. Here are just two examples:

1. On a creamery dryer

Drainage Method	*Air Temperature*
Restricted Blow-thru	250°
Group trapping (1 trap for 8 coils)	225°
Armstrong Unit Trapping (8 traps—1 for each coil)	**309°**

2. On a platen press

Drainage Method	*Processing Time*
Restricted Blow-thru	50 minutes
Group Trapping	35 minutes
Armstrong Unit Trapping	**25 minutes**

Why Unit Trapping Works Best

It is reasonable to assume that no two steam heated units will have *identical* condensing rates. Even the slightest difference in rate will cause a difference in steam pressure drops through the units. Here's where the trouble starts. Condensate from each unit may flow to the trap. But, what about air and other non-condensibles in the system? A difference in pressure drops too small to be indicated by an ordinary pressure gauge will permit backflow of steam from the higher pressure units to the lower pressure units. This backflow of steam may even impede flow of condensate from the lower pressure unit to the trap . . . and it will definitely impede or block off flow of air to the trap. The result is sluggish heating, reduced temperatures, reduced output, fuel waste and increased possibility of corrosion. Figures 1, 2 and 3 diagram the action.

Unit Trapping Not Costly

No engineer wants any more mechanical devices in his plant than are absolutely necessary. But, the moderate additional cost of using two or more small traps, instead of one big one, is saved over and over again in improved efficiency.

If the traps are Armstrong, maintenance is no problem. And users frequently tell us that Armstrong traps outlast others two and three to one.

Steam traps usually represent a fraction of 1% of the cost of the equipment they drain. Does it make good sense to lose 10% or more of equipment capacity to save a few dollars on traps?

Why not test Armstrong unit trapping in your plant. If you are not completely satisfied with the results you can return the traps for a full refund of the purchase price. There is little to lose—lots to gain. Call your local Armstrong Factory Representative or Distributor, or write **Armstrong Machine Works, 8105 Maple St., Three Rivers, Mich.**

ASK FOR the 44-page Steam Trap Book and reprint of article on Unit Trapping.

8015T

ARMSTRONG STEAM TRAPS

How Different Condensing Rates Can Slow Production

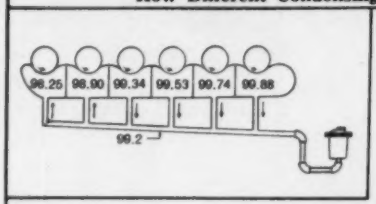

Fig. 1 This is a 6-roll ironer shortly after it has begun operating on 100 psi steam. When cold, wet material passes over chest 1, steam condensing rate is high and pressure drops accordingly. The pressure drop in chest 2 will not be as great, and so on down the machine as the material becomes progressively hotter and drier. Average pressure in the chests then is 99.27 lbs., and drain header pressure is slightly less, about 99.2 lbs. Under these conditions, steam from drain header enters chests 1 and 2 (as indicated by arrows at side of drain lines) because of pressure difference. Though condensate from chests drains by gravity, air can't leave chests countercurrent to incoming steam. Fig. 2 shows what happens next.

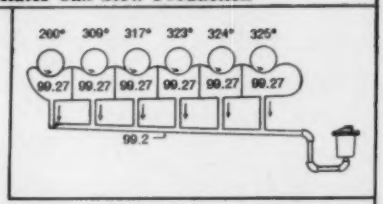

Fig. 2 This is the same 6-roll ironer after it has been operating a while. Air has accumulated in chests 1 and 2, reducing condensing rate and decreasing pressure drop. This process repeats itself down the line until pressures are as shown—that is, enough air will accumulate in each chest so that condensing rates and pressure drops of all chests will be about equal. The net result is shown in chest temperatures which are actual pyrometer readings taken on a 6-roll ironer, drained by a master trap, in a Chicago laundry. The laundry was making 337.9°F steam, but getting an average of only 309.6°F from the ironing surfaces, necessitating slow operation and frequent reruns. Then they tried Armstrong unit trapping—see Fig 3.

How Unit Trapping Prevents Trouble

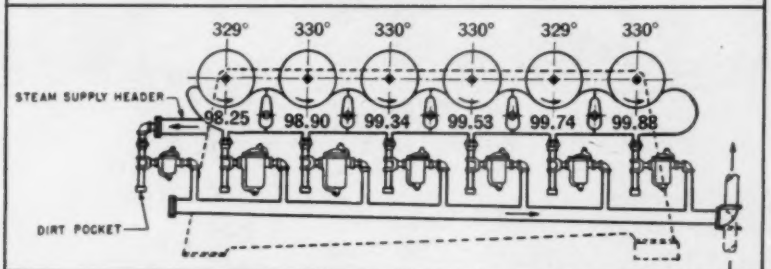

Fig. 3 This is the same 6-roll ironer, now unit trapped. Temperatures shown are also actual pyrometer readings—the average of 329.6°F is 20° higher than with group trapping. This is because air is continually removed from each chest into the drain header, and cannot get back into any chest.

For more data circle 536 on Post Card

Protect steel stacks with corrosion-resistant concrete

Corrosion-resistant concrete linings, made with LUMNITE calcium-aluminate cement and suitable aggregate, will protect stacks and breechings from the corrosive action of condensate.

When expanded shale aggregate is used, these linings also provide vital insulation. This keeps stack gases hot and helps maintain better draft for greater operating efficiency. The steel shell will stay cooler, too, extending the life of exterior paint. And these monolithic concrete linings have a lower unit weight, which reduces the dead load on the supporting structure.

Whether gunited or plastered, installation is easy and economical, with concrete reaching service strength in 24 hours. For even greater convenience, manufacturers of refractories offer castables bonded with LUMNITE cement – packaged mixtures ready for use with just the addition of water.

For more information, write Universal Atlas Cement, 100 Park Avenue, New York 17, N. Y.

"USS," "Atlas" and "Lumnite" are registered trademarks L-197

INSTALLATION: Elrama Station, Duquesne Light Company, Pittsburgh, Pa.

Universal Atlas Cement
Division of
United States Steel

Offices: Albany · Birmingham · Boston Chicago · Dayton · Kansas City · Milwaukee · Minneapolis · New York · Philadelphia · Pittsburgh · St Louis · Waco

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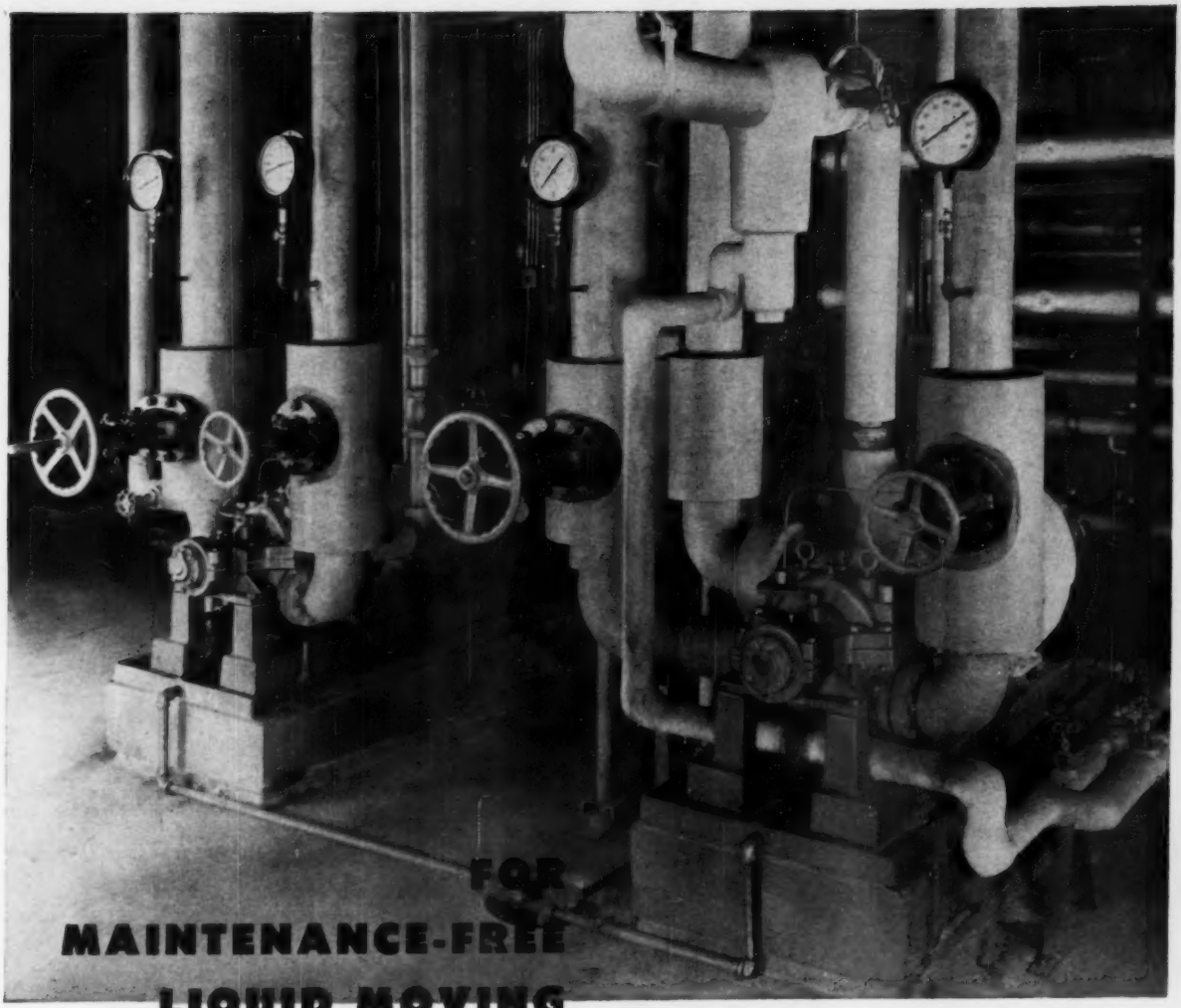
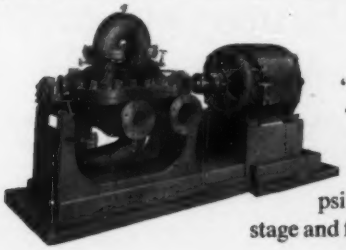


FOR MAINTENANCE-FREE LIQUID MOVING

"Buffalo" Class "RR" Pumps

For boiler feed and other high pressure, high temperature applications with clear water, "RR" Pumps deliver the utmost performance with an absolute minimum of maintenance. The unique "Buffalo" Class "RR" design is unsurpassed for consistent hydraulic balance. Rugged "Buffalo" construction features include efficient impellers — extra generous bearings and shafts — rigid casings with simply-formed passages to avoid friction losses — very deep stuffing boxes to accommodate more packing.



"Buffalo" Type "RR" Boiler Feed Pumps for pressures up to 500 psi. Available in two-stage and four-stage models.

These superior "Buffalo" design and construction features assure you of pumps that will stand up under continuous punishing service — that require practically no attention other than lubrication — that deliver more water at less cost for power.

The "Buffalo" Class "RR" Pump is your best buy for clear water service — hot or cold — against heads as high as 1500 feet — at capacities up to 900 gpm. Ask your nearby "Buffalo" engineering representative for full information, or write us for Bulletin 980-D.

"Buffalo" Pumps bring you the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

BUFFALO PUMPS

"Buffalo" PUMPS

Division of Buffalo Forge Co.

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Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

For more data circle 538 on Post Card

BULLETIN MSP-163
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Analog Computer Control
• No Tubes
• No Transistors
• No Slidewires
• Analog Computer Circuit Flexibility
• Interchangeable Plug-in Modular Control Elements
• Designed to Complement Digital Computer Control
• No Lag, DC Signal Transmission for All Process Control Applications
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• Not Affected by Shock or Vibration
• Simple to Understand
• Easy to Install and Maintain
HAGAN CHEMICALS & CONTROLS, INC.
PITTSBURGH, PA.

Send for this bulletin. Hagan's PowrMag analog computer control offers the highest degree of flexibility yet devised for industrial control. A new bulletin, MSP-163, shown above, gives full details on the system, the magnetic control units, the patchboard, and provides useful information on determining computer requirements.

HAGAN CHEMICALS & CONTROLS, INC.

DIVISIONS: CALGON COMPANY, HALL LABORATORIES

HAGAN BUILDING, PITTSBURGH 30, PA.
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Consult this expert on plant location

Build Your Plant Near An Unlimited Fuel Supply

The Squirrel is a sound planner. He builds his nest near Hickories and Oaks so that he will have a plentiful supply of nuts and acorns . . . *"fuel" for the Squirrel!*

Take a tip from the Squirrel. Locate your new plant near a large reservoir of fuel . . . Peabody's two-billion-ton coal reserves. Since shipping charges are a big part of your fuel costs, this close proximity to a dependable coal supply is just good business. It assures your Company an economical source of power for now *and* the years ahead, and protects your capital investment in buildings and equipment.

Let Peabody help you select *your* new plant site—it's an important part of our service . . . and one that can save your Company *millions!*

Learn more about the location of Peabody's 29 modern mines and river dock loading facilities. Write Industrial Development Division, Department PE.

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For more data circle 540 on Post Card

THIS IS THE TRAP FOR HIGH PRESSURE POWER PLANT JOBS

Pressures *high?* Temperatures really *hot?* Then the Yarway Integral Strainer Trap is the steam trap for the job.

Yarway Integral Strainer Impulse Steam Traps drain some of the hottest steam lines in the country, with temperatures to 1050°F and pressures as high as 2500 psi.

These traps have ample capacity when system is being warmed up, yet handle relatively small amounts of condensate without losing prime. In the presence of dry or superheated steam, the trap valve snaps shut.

Utilities and other high pressure plants also benefit from further advantages like *small size, light weight, steel construction, easy maintenance.* Available in six sizes, flanged or welding ends.

Over 1,250,000 Yarways already sold. For full information, call your local Yarway Representative or write

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

SERIES 60—normal needs, pressures to 400 psi, 6 sizes. **SERIES 120**—normal needs, pressures to 600 psi, 6 sizes. **SERIES 40**—for extra heavy loads, 5 sizes. **NO. 30**—for extra light loads (½" only). **INTEGRAL STRAINER**—highest pressures and marine use, 6 sizes.

YARWAY *impulse® steam traps*

For more data circle 541 on Post Card

TRACERS

Power Engineering's Monthly Probe of Power Facts

Magnesium hydroxide — the familiar milk of magnesia — is being used successfully to combat air heater corrosion in the public utilities field. It is blown into the furnace as a separate stream, and has proved to be just as effective used this way as if added to the oil earlier. The vanadium acts as a flux, which makes the slag melt at low temperature. This practice also tends to eliminate fly ash. Cost, based on magnesium hydroxide at $67 a ton F.O.B. shipping point, is about 2 cents per barrel of oil. On the atom basis, the magnesium-vanadium ratio should be about 2 to 1 for a boiler; for gas turbines, it should be stepped up to 3 to 1.

Copper pick in the feedwater cycle is a problem with which many stations are wrestling. At Philo, copper runs from 10 to 30 ppb or roughly 0.3 lb per day going to the turbine, most of it apparently being traced to the high-pressure heater. Final conclusion is that nothing more can be accomplished chemically and that all copper must be removed from equipment used in that part of the cycle. On the treatment-with-chemicals side of the picture, R. A. Wilson of Allis-Chalmers, speaking at an Inco conference, said that the introduction of amines first decreases copper content of feedwater, then the copper tends to increase and finally evens out. Much of the copper, Wilson states, can be removed by filtration.

At Little Gypsy Station of Louisiana Power & Light Co, a condensate scavenging system is expected to effect economies which will total over $10,000 a year. D. M. Spillane analyzes the figures, in his article on page 78.

A-c electricity produced by direct conversion of heat — and in significant amounts, without the use of rotating machinery or dc-ac converter — is reported by scientists working at General Dynamics Corp. They used a high-temperature cesium cell converter. The a-c produced is in the high range of 100 kilocycles.

About one-third of the Bell System's annual expenditure for power equipment is for storage batteries to back up the usual alternating current power supply. Most common battery in use today is the lead-acid battery. An alloy of lead-antimony has been used as a battery grid, giving a life service of 14 years. Substitution of calcium as the alloy has increased life of the battery to 25 years.

For a full description of Bulldog Electric's radically different type of bus duct — the new XL Bustribution Duct — see page 71. It has complete dead-front safety, single-bolt joint, labor savings in installation, other advanced features.

An incandescent lamp, so small it can be passed through the eye of a darning needle, has been placed in production by Sylvania. Said to be the smallest mass-produced incandescent lamp in the world, the new lamp has immediate applications in transistorized circuits in computers and electronic systems, and is expected to open up new frontiers in microminiature transistor circuitry.

What Causes Explosion In Air Compressors?

Compressor explosions, while usually serious, are regarded as rare occurrences. But there is a rising demand for information about the conditions which contribute to this hazard. This article explains and presents the value today of fire-resistant lubrication

Fig. 1. Piece of steel pipe after explosion in compressor had driven it into the ceiling. Cause: overheated manifold ignited the oil lubricant used

By J. A. MATHE*

ESSENTIALLY, an explosion in a compressed air system is the result of ignition of its lubricating oil. Various factors can contribute to this ignition.

Type of equipment plays a role. Air compressors are of three basic types: reciprocating piston, rotary, and centrifugal. The explosion hazard is least serious in the third type because the lubricant is external to the compressor case and can enter only by leakage. But explosions have occurred in these centrifugal compressors.

Excessive valve deposits are potential ignition sources. Some studies of the problem indicate that valve deposits can become so hot that they incandesce, thus igniting petroleum vapors. Bureau of Mines data indicates that compressor deposits formed from petroleum oil react exothermically with air under certain conditions of temperature and pressure. Therefore an increase in temperature can occur in the vicinity of the unit's exhaust valves.

This data also reveals that temperature build-ups can reach the auto-ignition points of petroleum oils. The danger here is compounded because the auto-ignition point of a petroleum oil drops rapidly as pressure builds. Most petroleum oils have auto-ignition points around 700–750 F at atmospheric pressure. But by the time pressure has reached 100 psi, auto-ignition has dropped to around 400 F or lower.

Another and more familiar result of the formation of valve deposits is when a fouled valve may stick in open position. This permits repeated recompression of hot air which rapidly raises temperature to a point where the lubricating oil or its vapors can ignite spontaneously.

Failure of coolers, or even a reduction in the efficiency of cylinder jacket coolers between stages and after-coolers, can result in extreme air temperatures. If temperature climbs to the auto-ignition point of the oil, the explosion hazard exists.

High ambient temperatures are a factor sometimes overlooked even by operators who have paid strict attention to conditions within the compressor itself which might lead to an explosion. In the Southwest, for instance, explosions and fires in air headers are more frequent during the hot summer months. Ambient temperatures also become a critical factor in hot plants where the input air to a compressor is pulled from the interior of the plant rather than from the outside.

Heavy duty service can create an explosion hazard when the compressor involved is not designed for continuous operation. Modern compressors are designed in multi-stages to minimize the overheating which results from hard "driving." But many of the units in present-day use are of the older single-stage type. If such a compressor isn't designed for continuous operation, long runs will probably overheat it seriously.

Over-lubrication can present an additional explosion hazard. Proper lubrication rate varies not only with the design of the compressor, but also with its general condition and the type of service expected of it. When a unit begins to show signs of ring and cylinder wear, or dry spots on cylinder walls, the natural reaction is to increase the lubrication rate. If a slight increase doesn't solve the problem, the maintenance department is faced with a dilemma. Should they accept high wear rate or, by cutting it with a still higher lubrication rate, contribute to the explosion hazard presented by over-lubrication? A hard and fast answer is impossible, although a serious compressor explosion is a rather high risk to run in order to get a few more months of service from the compressor!

Poor maintenance is a general term which includes much of what has been covered above. No doubt poor maintenance can contribute to a compressor explosion hazard, but the term is somewhat unfair in that it tends to make the maintenance man the "fall guy" for conditions over which he may have had little control. If production demands 24-hour operation, and the compressor can't be shut down for routine maintenance, excessive valve deposits will probably form. The reason wasn't *poor* maintenance, but rather *no* maintenance!

It's true that various factors contribute to compressor explosion hazards. But there is one common thread running among all of these factors — they all result in ignition of the compressor's petroleum lubricating oil.

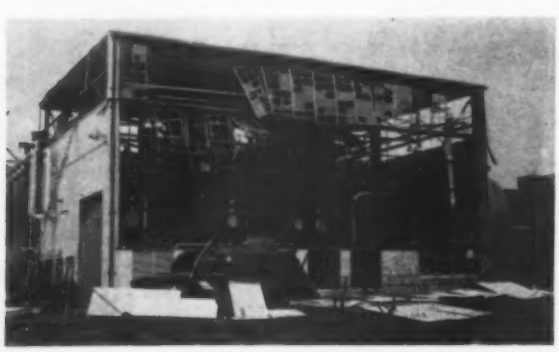


Fig. 2. Eloquent testimony to the violence of air-oil explosions. Pipeline forming a closed loop used in compressor testing ruptured in two places. Resulting explosion blew entire wall away

* Lubrication Engineer, E. F. Houghton & Co

Therefore, compressor operators and builders, in increasing numbers, are taking the logical step of replacing combustible petroleum oils with lubricants which won't ignite; and for this purpose we are fortunate to have a ready-made group of lubricants — the synthetic fire-resistant hydraulic fluids of the phosphate ester type.

The fact is that phosphate ester hydraulic media combine, to greater and lesser degrees, the lubricity needed for efficient operation with a resistance to ignition not obtainable in a petroleum oil.

Recent Tests

In recent tests conducted by a prominent compressor builder, a phosphate ester fluid was found to have lubricity characteristics "as good as oil." These tests ran for periods of 100 to 250 hours during which no frictional heat build-up was observed and no corrosive tendencies were exhibited.

In another series of tests conducted by a different agency, a diesel engine was modified to determine the compression ratios at which various compressor lubricants would ignite spontaneously. The tests showed that conventional compressor oils ignited at ratios of about 15 to 1. On the other hand, two Houghto-Safe fluids demonstrated compression ratios of 47 to 1 and 49 to 1. The ASTM auto-ignition temperatures of these two esters are both over 1200 F, while the auto-ignition temperatures of conventional petroleum oils are between 700 and 800 F.

All three types of air compressors may be driven by steam, electric, diesel, gas, or gasoline engines. They may be directly coupled or driven by belt, chain, or gear. An F-R fluid *is not needed and should not be used* to lubricate any of these drive units. But the ester fluids *are* suitable and needed for lubrication of the air cylinders of the reciprocating and rotary types of air compressors, and for lubrication of bearings in the centrifugal type.

In reciprocating piston compressors of the cross-head type, the running gear does not require a fire-resistant lubricant, although an ester with proved lubricity characteristics will be satisfactory. The lubrication system for the running gear is usually separate from the lube system for the air cylinders, so the operator can continue to use petroleum oil for the running gear while he uses the F-R fluid for the air cylinders. But if a central automatic lubricator distributes the same lubricant to the running gear and the air cylinders, then an F-R fluid should be used for both.

Step-by-step Changeover Schedule for Compressors from Oil to Phosphate Ester Fluid

1. SIGHT FEED FLUID. Drain and fill with pure glycerine. If plastic sight is used, replace with glass.
2. FORCE FEED LUBRICATOR BOX. Drain. Remove any internal paint. Replace shaft seal on lubricator box with butyl rubber or polysulfide-impregnated leather packing. Add F-R fluid to the lubricator box.
3. LUBRICATOR RATE. Set the automatic lubricator for a rate 50 per cent higher than the manufacturer recommends. Check all lubricator lines to insure that all lines are clean and functioning properly.
4. AIR CYLINDERS. Make certain that all cylinder components (rings, cylinders and valves) are in good condition.
5. CRANKCASE. If F-R lubricant is to be used in the crankcase, remove paint prior to filling.
6. TRAPS. If water traps are used on the lubrication lines between the force-feed lubricator and the air cylinder, they should be inverted if trap design permits. If plastic water traps are used on the air lines, they should be replaced with steel traps.
7. INTERCOOLERS. Clean thoroughly. Special attention should be given to the air side of the cooler which may contain dormant petroleum residues which will be removed by a phosphate ester fluid.

It's also possible that an operator who utilizes a separate lubrication system for running gear will prefer the same lubricant for air cylinders in order to obtain the economies of using one product rather than two. In this case an F-R fluid can be used because it will perform as well as petroleum oil.

Conversion to a F-R Fluid

Changeover to fire-safe compressor lubrication is a simple operation and inexpensive, although the cost of the phosphate ester fluid is higher than that of a straight oil. Also, certain basic differences between the two media do exist. It's necessary, therefore, to compensate for the introduction of the phosphate ester lubricant by observing the general changeover rules laid down by the suppliers of the F-R fluids.

Intercoolers are generally used in multi-stage air compressors. In units which have seen long service, the air sides of the intercoolers sometimes become heavily coated with petroleum residues. An F-R lube in the air stream may lift these deposits, and the air stream will blow them into the next stage, where they may cause ring wear, interfere with the operation of the air cylinders, or even jam the rings and valves. To minimize this possibility, inspect the air side. Heavy deposits should be cleaned out by caustic wash or strong solvent. (This is good maintenance even when no changeover to a phosphate ester lube is contemplated.)

Lubricators are frequently of the automatic sight-feed type. If the sight-feed indicators contain pure glycerine, no change is necessary. But certain other sight-feed fluids, such as a 50-50 mixture of glycerine and water, are not compatible with the phosphate ester, and conversion to pure glycerine is a necessary part of the procedure.

Packing of the crankshaft in the lubricator sump should also be changed to a butyl rubber or to a rubber-impregnated leather packing material.

Rate of Lubrication

Lubrication rate can be increased moderately over the rate for petroleum compressor oils. After a few hours of operation with the new lube the air cylinder should be opened and the walls and valves inspected for uniformity and amount of wetting. If over-wet, cut back on the lube rate, although over-lubrication is not critical.

Houghton recommends a 50 per cent increase in lubrication rate after changeover to its Houghto-Safe fluid This is probably unnecessarily high in view of the fact that actual application has proved the fluid's lubricating abilities. The relatively high rate of increase does no harm and provides double assurance of proper lubrication.

Packings were touched on above. There's no changeover connected with shaft packings of air cylinders because metal and other inert materials usually comprise these seals. At other points of contact between the lubricant and packing material (including the lubricator sump mentioned) buna packings should be replaced with butyl seals compatible with a phosphate ester.

Moisture traps on air lines need no changeover if they are constructed of steel or another metal. If they are plastic, they should be converted to steel when the phosphate ester is introduced. If they contain molded rubber components, these should be butyl.

Water traps are sometimes used on the lubrication lines between the lubricator sump and the air cylinders. Since the density of the phosphate ester is greater than that of water, these traps should be inverted if at all possible. THE END

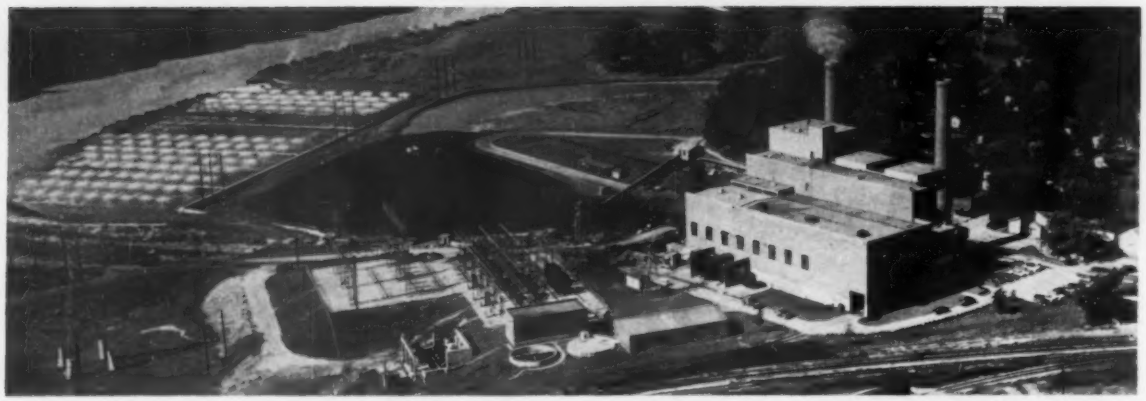


Fig. 1. General view of Dale Generating Station, East Kentucky Rural Coöperative Corp, Ford, Kentucky. Spray pond at left, on river bank, operates without pumping power, will be described in detail in a feature article to be published soon

We Selected Dale Station Unit No. 3 for Best Economy, Not Best Efficiency

In adding Unit No. 3 at Dale Station, Ford, Kentucky, comparisons were made of various combinations of 44,000-kw and 66,000-kw units, preferred standard and handbook, reheat, various pressures and temperatures. Here are details of the analysis and its result

By T. D. WENGER and R. H. STANLEY *

HOW IMPORTANT is a low station heat rate? With continually rising fuel costs, much emphasis has been laid on squeezing the last Btu out of central station heat rate. But this is not the only factor to be considered in selecting central station equipment. More efficient equipment is often more costly and may require more attention. Reserve capacity and anticipated load growth will certainly affect the economics of equipment selection. There may also be physical limitations on size and arrangement.

The selection of unit size for the third unit of the Dale Generating station at Ford, Kentucky, illustrates the fact that the equipment which is the best selection for a given installation will not always be the most efficient.

In 1953, the East Kentucky Rural Electric Coöperative Corp began plans for the addition of a third unit to the Dale Station. First two units, both 22,000-kw units, were still under construction and would not be on the line until 1954. However, a load study indicated that more generating capacity would be required as soon as additional units could be placed in operation. Analysis of the power consumption of the member distribution coöperatives supplied by EKRECC showed that either three 44,000-kw units or two 66,000-kw units would carry the system demand for approximately 12 years. Selection of unit No. 3 would set the pattern for future units.

Inasmuch as previous site studies, as well as the load study, indicated that the 3rd and 4th units should be in the range of 44,000 to 66,000 kw, six possible units in this size range were chosen for comparison. These included the units shown in Table I.

Layout Studies

In addition to purely economic factors, there were other considerations involved in unit selection. First, the plant site had originally been laid out for the two 22,000-kw units plus two future 44,000-kw units. The initial plant was arranged so that plant expansion would be toward the coal-handling equipment. Location of the equipment therefore limited the amount of expansion. Layout study was made that indicated that two future units, each with a turbine-generator length not exceeding 65 ft, could be installed in the available space. Additional units, or units of a larger size could not be installed without extensive and costly relocation of coal-handling equipment.

Secondly, reserve capacity was not a limitation in unit selection. EKRECC had entered into a contract with TVA, under which TVA would provide emergency stand-by and maintenance stand-by power. The cost of this reserve would vary somewhat, depending on unit size, but this variation was not a primary factor in unit selection.

Construction costs for each of the six possible units were estimated. These figures (based on 1953 costs) are shown in Table I. The 66,000-kw preferred standard unit was estimated to have the lowest construction cost per kw, $129.

Next important factor which was considered was the station heat rate which could be attained with each of the six units studied. Heat rates for these units are shown in Table II. These rates are also plotted in Fig. 2, together with the heat rates for the two 22,000-kw initial units at the generating station. The curves in Fig. 2 show the heat rates for various loads on the units. All heat rates are those for net kwh output after allowance has been made for station auxiliaries and a 97 per cent operating ratio.

Comparative over-all power cost for each of the units was then computed for annual load factors of 60 per cent and 80 per cent. Comparative power costs, expressed in cents

*Both of Stanley Engineering Co

Table I. Estimated construction cost, Unit No. 3 of Dale Generating Station. These figures are based on costs in 1953

Unit Size		40,000	44,000	44,000	60,000	60,000	66,000
Unit Type		Handbook	P.S.	P.S.	Handbook	Hdbk.-Reheat	P.S.
Steam Characteristics, psi/deg F		1450/1000	850/900	1250/950	1450/1000	1450/1000/1000	1250/950
Acc. No.							
311	Power Plant Structures	$ 650,000	$ 650,000	$ 650,000	$ 750,000	$ 840,000	$ 750,000
	Miscellaneous Yard Improvements	130,000	130,000	130,000	130,000	130,000	130,000
312	Boiler Plant Equipment						
	Boilers	1,326,000	1,216,000	1,274,000	1,757,000	1,707,000	1,704,000
	Boiler Feed Pumps	90,000	65,000	80,000	120,000	120,000	110,000
	Heat Balance Equipment	85,000	80,000	80,000	125,000	125,000	120,000
	Power Piping	530,000	480,000	500,000	730,000	760,000	720,000
	Control	53,000	50,000	50,000	62,000	75,000	60,000
	Yard + Miscellaneous	220,000	220,000	220,000	275,000	260,000	275,000
	Coal Handling	—	—	—	—	—	—
	Ash Handling	40,000	40,000	40,000	48,000	48,000	48,000
314	Turbine-Generator Equipment						
	Turbine Generators	1,400,000	1,385,000	1,420,000	1,780,000	1,985,000	1,790,000
	Condensers	210,000	225,000	215,000	310,000	270,000	330,000
	Spray Water System	220,000	220,000	220,000	275,000	250,000	280,000
315	Accessory Electric Plant	500,000	500,000	500,000	700,000	700,000	700,000
	Other Auxiliary Plant	200,000	200,000	200,000	300,000	300,000	300,000
	Estimated Contract Cost	$5,654,000	$5,461,000	$5,579,000	$7,362,000	$7,570,000	$7,317,000
	Plus Contingencies	341,000	328,000	333,000	442,000	453,000	441,000
	Plus Engineering, Legal + Overhead	565,000	546,000	558,000	736,000	757,000	732,000
	Estimated Construction Cost	$6,560,000	$6,335,000	$6,470,000	$8,540,000	$8,780,000	$8,490,000
	Cost per kw of Gross Capability	$ 164	$ 144	$ 147	$ 142	$ 146	$ 129

Table II. Heat rates for Unit No. 3. These rates are also plotted in Fig. 2, along with rates for two initial 22,000-kw units

Unit Size	40,000	44,000	44,000	60,000	60,000	66,000
Unit Type	Handbook	P.S.	P.S.	Handbook	Hdbk.-Reheat	P.S.
Steam Characteristics	1450/1000	850/900	1250/950	1450/1000	1450/1000/1000	1250/950
Load, kw	40,000	40,000	40,000	60,000	60,000	60,000
Turbine Cycle, Btu/kwh	8,711	9,336	8,964	8,681	8,290	8,938
Boiler Efficiency, %	88	88	88	88	88.3	88
Heat Input to Boiler, Btu/kwh	9,899	10,600	10,200	9,864	9,389	10,170
Add for Auxiliary Power, Btu/kwh	613 (1)	636 (2)	632 (1)	612 (1)	612 (1)	629 (1)
Calculated Heat Rate, Btu/kwh	10,512	11,236	10,832	10,476	9,952	10,799
Add for Operating Ratio, Btu/kwh (3)	316	337	325	315	298	324
Station Heat Rate, Btu/net kwh	10,828	11,573	11,157	10,791	10,250	11,123

(1) At 6.2% (2) At 6.0% (3) At 97%

per kwh, included only the following elements of cost:

1. Fixed charges at 5.05 per cent applied to the estimated construction cost of the unit. These fixed charges included interest at 2 per cent, depreciation at 2.75 per cent, and taxes and insurance at 0.3 per cent.

2. Fuel cost based on station heat rates previously determined and using a fuel cost of 20 cents per million Btu.

3. Additional operating labor of $52,000 per unit which would provide 13 men at $4000 per year.

All other items of expense, including maintenance, supplies, general plant supervision, and coal handling, were omitted as they were assumed to be comparable for any of the units studied. Over-all power costs are shown in Table III.

In comparing the units in the 40,000- to 44,000-kw range, it was rather obvious that the 44,000-kw preferred standard unit at 1250 psi and 950 F showed a lower cost at both load factors studied. This unit involved an investment that was only 2 per cent above the 44,000-kw, 850-psi, 900-F preferred standard unit, and considerably less investment per kw than the 40,000-kw handbook unit at 1450 psi, 1000 F. Therefore, within the 40,000- to 44,000-kw range, the 44,000-kw, 1250-psi, 950-F unit was the logical choice.

Higher-Range Unit Comparison

In comparing the units in the 60,000- to 66,000-kw range, it was first apparent that the 60,000-kw handbook unit at 1450 psi and 1000 F offered no advantage over either the 60,000-kw reheat unit or the 66,000-kw preferred standard unit. Comparative cost for the handbook unit was the highest of the three at both load factors studied.

Between the 60,000-kw reheat unit and the 66,000-kw preferred standard unit there was very little economic advantage one way or the other. The 60,000-kw reheat unit showed a slight advantage at 80 per cent load factor, but the 66,000-kw preferred standard unit was more favorable at the 60 per cent load factor. It was estimated that system load factors for an extended period of time would fall somewhere within this range, and therefore there was little to choose between these units on a strictly economic basis. The 66,000-kw preferred standard unit did, however, have the following definite advantages:

1. For 3 per cent less investment, it provided 6000 kw more of gross capability.

2. Its cycle was somewhat simpler than the reheat unit.

3. Its length was 65 ft maximum, so that two units of this size could be accommodated in the limited available space for units 3 and 4. On the other hand, a 60,000-kw reheat unit would be approximately 70 ft 2 in. in length, and the installation of two of these units would require modifications to the coal-handling equipment.

For these reasons, a 66,000-kw preferred standard unit at 1250 psig, 905 F seemed to be the best choice in this larger size range.

Table III. Comparable incremental power costs. 44,000-kw preferred standard unit should lower cost at both load factors

Unit Size	40,000	44,000	44,000	60,000	60,000	66,000
Unit Type	Handbook	P.S.	P.S.	Handbook	Hdbk.-Reheat	P.S.
Steam Characteristics	1450/1000	850/900	1250/950	1450/1000	1450/1000/1000	1250/950
Investment per kw	$ 164	$ 144	$ 147	$ 142	$ 146	$ 129
Fixed Charges per kw	8.28	7.27	7.43	7.17	7.38	6.52
Incremental Operating Labor per kw	1.30	1.18	1.18	0.87	0.87	0.79
Station Heat Rate, Average Btu Per Net kwh						
60% Load Factor	11,300	11,900	11,530	11,080	10,520	11,280
80% Load Factor	10,950	11,620	11,220	10,840	10,300	11,130
Annual Costs per kwh @ 60 % Load Factor						
Fixed Charges	0.158¢	0.139¢	0.142¢	0.137¢	0.141¢	0.124¢
Fuel	0.226	0.238	0.231	0.221	0.211	0.225
Operating Labor	0.025	0.022	0.022	0.017	0.017	0.015
Total	0.409¢	0.399¢	0.395¢	0.375¢	0.369¢	0.364¢
Annual Costs per kwh @ 80% Load Factor						
Fixed Charges	0.118¢	0.104¢	0.106¢	0.102¢	0.105¢	0.093¢
Fuel	0.219	0.232	0.224	0.217	0.206	0.223
Operating Labor	0.019	0.017	0.017	0.012	0.012	0.011
Total	0.356¢	0.353¢	0.347¢	0.331¢	0.323¢	0.327¢

Choice of units was then narrowed to the 66,000-kw preferred standard unit at 1250 psi, 950 F, and the 44,000-kw preferred standard unit at 1250 psi, 950 F. In comparing these two unit sizes, several advantages appeared for the 66,000-kw unit:

1. Cost per kwh would be significantly less. Referring again to Table III, the power cost favored the 66,000-kw unit by 8 per cent at 60 per cent load factor, and by 6 per cent at 80 per cent load factor.

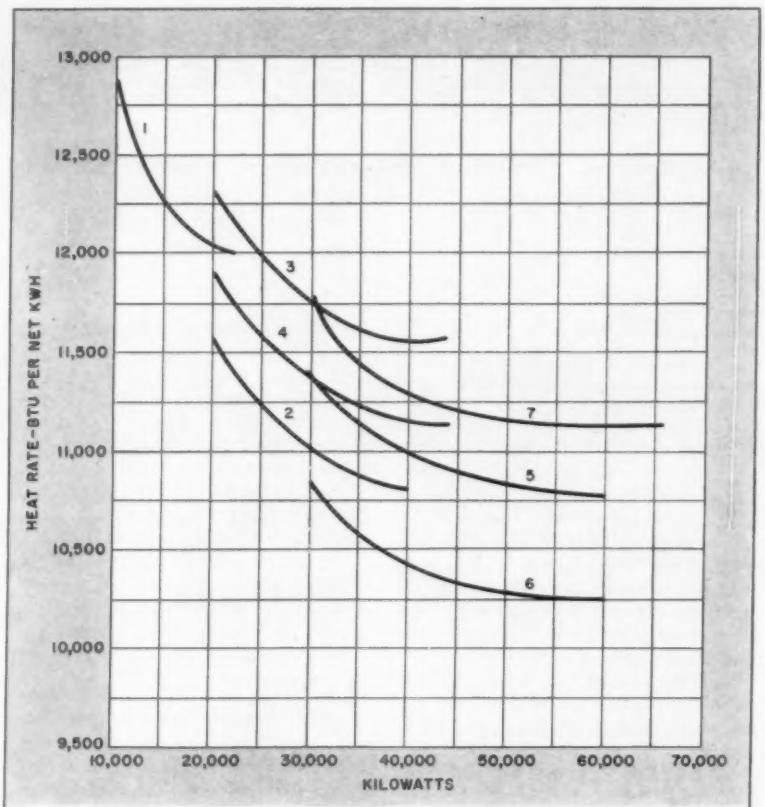
2. If the 66,000-kw unit were chosen, a total of 176,000-kw capacity could be installed without relocating coal-handling equipment. On the other hand, if 44,000-kw units were selected, only a total of 132,000 kw could be installed at the Dale Station without being involved in major relocation of coal-handling.

3. With the use of a 66,000-kw unit, the installed capacity by 1956 or 1957 would be approximately 110,000 kw as compared with 88,000 kw for a 44,000-kw third unit. Thus the larger unit would provide a higher early installed capacity.

4. Over a long range, the total investment required for two 66,000-kw units, as compared with three 44,000-kw units to obtain the same capacity, would be considerably less. Using the figures in Table I and allowing $575,000 for the changes required in the coal-handling system if three 44,000-kw units were installed, it can be seen that the cost per kw of installed capacity for all units at the plant would be $156 per kw if three 44,000-kw units were installed, and $139 per kw if two 66,000-kw units were installed.

5. An interconnection arrangement with the Kentucky Utilities Co was under study. If this interconnection arrangement became a reality, the use of 66,000-kw units would be better than 44,000-kw units in that the larger size more closely matched the units installed in the generating plants of the Kentucky Utilities Co. This would greatly facilitate mutual interchange and the staggering of construction schedules.

Thus a 66,000-kw preferred standard unit was selected. It was neither lowest in heat rate nor lowest in total construction cost of the six units considered. But under careful study, it proved to be the best and most economical selection. THE END

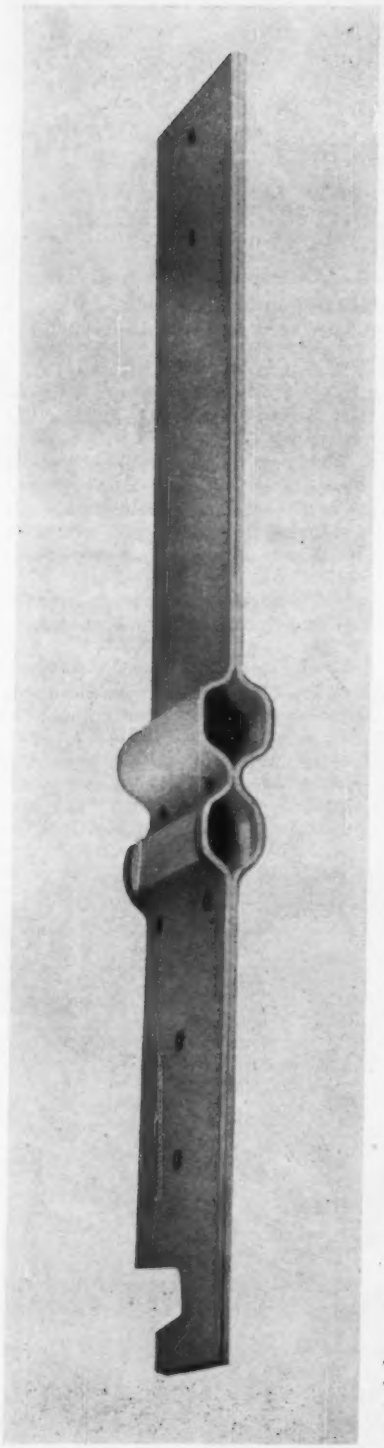


KEY

RATING	TYPE	PSI/DEG F	RATING	TYPE	PSI/DEG F
(1) 22,000 KW	P.S.	850/900	(5) 60,000 KW	HANDBOOK	1450/1000
(2) 40,000 KW	HANDBOOK	1450/1000	(6) 60,000 KW	HDBK-REHEAT	1450/1000/1000
(3) 44,000 KW	P.S.	850/900	(7) 66,000 KW	P.S.	1250/950
(4) 44,000 KW	P.S.	1250/950			

Fig. 2. Net station heat rates at Dale. Curves apply to various loads on units

Electrical Industry Gets New Type Bus Duct



Originator of bus duct has developed a radically different type of flexible wiring system for power and lighting distribution. Low voltage-drop, smaller size, and less installation cost are outstanding features of this new product. Buses are joined by single bolt

UNTIL ABOUT 1930, all industrial power and lighting wiring was done with wire and conduit, or simply with open feeders. While these methods were satisfactory for fixed loads, they both had two drawbacks; there was no flexibility, and rearrangement of circuits was quite expensive and time-consuming.

Under the above types of wiring, it was necessary to shut off the power when making changes. This feature was undesirable, or intolerable, in most industries.

Next came the wireway, or cable-duct system. This gave the needed flexibility, but did not overcome the need for shutdown when taps were made. So it was inevitable that modern bus duct should be developed.

Over the years, bus duct has been constantly improved, eventually to produce the flexible, plug-in type, which has been standard for the electrical industry for some time. However, there have been some undesirable features inherent in all present-day types. The labor of installation has been high, and additional safety features were needed.

Now, after several years of re-examination, the originator of bus duct has announced what appears to be a perfect answer to the problem. In this restudy of existing products, certain requirements had to be met. These requisites were: 1. Maximum safety features; 2. capability of withstanding unusually high mechanical and electrical stresses; 3. necessary low voltage-drop; 4. adequate design for use of both copper and aluminum bus bars; 5. incorporation of a simplified joint, with minimum number of bolts, and designed for dead-front maintenance; and 6. type of casing which would be compatible with present building structural modules.

After considerable research and development, a radically different bus duct has emerged. It is known as XL Bustribution Duct, and is manufactured by the Bulldog Electric Products Div of I-T-E Circuit Breaker Co. Some of the design features of this new product will be of great interest to power engineers.

First, the individual bus bars are a complete departure from past designs. Instead of a single bar of metal, this new bus is laminated of two pieces. This feature provides inside contacts for the bus plug finger, and allows for expansion and contraction of the metal. Figure 1 shows a detail of this construction. Smaller reinforced opening is for the bus plug contact; large opening is for expansion of the bus.

Bus bars are plated with successive coatings of zinc, copper, and silver wash. Then, the laminated pairs of bars are encased in a heavy wrapper of Butyl plastic material, to provide the necessary insulation required for close spacing. There are ten plug-in points and ten expansion points on each bus bar.

Fig. 1. Section of bus, showing openings for expansion and plug-in contact

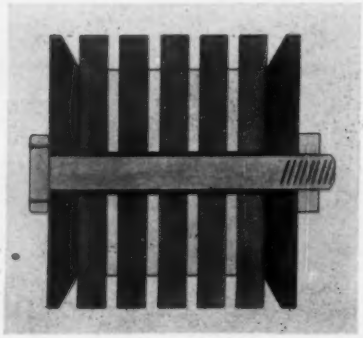


Fig. 2. Drawing shows assembly of buses, spacer-insulators, one-bolt joint

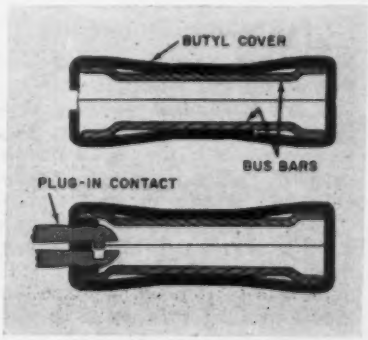


Fig. 3. Illustrations of insulated bus, and same detail with contact inserted

Fig. 4. Electricians Barry and Schoeninger are installing Bustribution duct, used in Detroit's Convention Exhibit Hall

Fig. 5. Ten take-offs per section will provide plenty of circuits for power and general electrical requirements in Exhibit Hall

To obtain the desired voltage-drop characteristic, the bus bars are placed on ¼-in. centers. This feature necessitates an entirely new type of connection at the bar ends, because there is obviously not enough space for individual bolting of the bars.

One of the most unique points in the new design is the single-bolt joint, a one-bolt fastener for all bus bars. The complete fastener consists of a bolt (with an insulating sleeve), insulating washers between buses, and Butyl seal rings (which prevent tracking between buses). A detail of the assembled joint is shown in Fig. 2.

Complete dead-front safety, for plug-in operations, is provided in the design of the Butyl bus-insulating wrapper. Figure 3 shows how the Butyl completely encloses the bus, but has a provision for insertion of the plug-in contacts at the correct openings.

Insulating dividers are placed between the bus bars, continuously between the expansion offsets. In addition, C-clamps are installed, to clamp the bus bars rigidly together. These are welded to the casing which encloses the bus duct.

Fewer Supports Needed

Since the casing is constructed with an H-beam shape, the entire bus duct system assumes the characteristics of a structural member. This feature results in the need for fewer supports; in fact, it can be supported quite satisfactorily on 10-ft centers.

This is a most important feature in the total installed cost of bus duct. Some high-ceiling hangers can be quite expensive; most buildings provide a point of attachment on 10-ft modules.

In addition to the design features of the new bus duct, an entirely new concept in plug-ins has been developed. Simple, easy installation has been provided, with complete dead-front design.

New XL Bustribution Duct will be available in ampere ratings of 225 through 1000 amp; voltage ratings through 600 v, single-phase, three-phase; and three-phase 4-wire, with full neutral in all sizes.

Editor's note: Since World War II, bus duct has had wide acceptance in the electrical field. Industry was quick to capitalize on its versatility and flexibility.

In many projects, however, some of the economic (and operational) advantages of bus duct have been lost, due to the high cost of installing or moving the duct.

This new product would appear to be one which can be installed cheaply — and moved quickly and easily. Of particular interest is the ease with which the one-bolt bus connection can be made. Contrasted to the old style method of joining the individual buses, this scheme is amazingly simple.

While the buses of this new product are of aluminum, the design is equally adaptable to copper, if necessary.

For more information, write the Editor, or jot XL Duct on the enclosed Inquiry Card. THE END

Fig. 6 shows an electrician tightening the single bolt which connects ten-foot length of XL Bustribution Duct. Tightening four-duct casing screws completes the joint

Do You Want 10,000-psi Pressure From Your Plant Air Supply?

Often, a maintenance problem can be solved quickly if a high-pressure source is available. Small oil-hydraulic boosters will furnish this power, and can be operated from existing compressed-air supply. Booster and work cylinder make inexpensive hydraulic press

A BASIC LAW of physics dictates that pressures, in piston-type rams, are inversely proportional to the areas of the pistons. In other words, if the piston has 10 sq in. of surface area and the ram has one sq in., a pressure of 10 psi on the piston will exert 100 psi on the ram.

By this elemental reasoning, a pressure of 100 psi, applied to a 100 to 1-ratio booster, will deliver 10,000 psi of pressure. This can be done in a small, compact booster — for plant maintenance work.

Prime-mover for the air-hydraulic booster is any source of compressed air. And since practically all power plants have such a supply available, there's no question as to primary power.

A booster of this type is simply an air cylinder which has its piston rod enclosed in an oil-filled pressure chamber. When air is applied to the piston, the piston rod becomes a hydraulic ram and transmits the total air cylinder thrust to the confined oil. Thus, the plant air pressure is converted into higher hydraulic pressure.

Figure 1 gives a graphic demonstration of the principles involved in an air-hydraulic booster. While the example shows only a 10 to 1 ratio, it is possible to obtain a 100 to 1-ratio booster.

In its simplest form, a small hydraulic press could be constructed with an air-hydraulic booster, a work cylinder, and the connecting piping. Figure 2 shows such an arrangement. In actual application, it would be necessary to harness the work cylinder to the work.

By the use of special attachment fixtures, high-pressure devices (such as gear-pullers) can be temporarily installed at the point of need. Or a permanent installation can be made in the plant maintenance shop.

For permanent locations, such as hydraulic presses, a more elaborate installation is required. However, the basic principle is the same. Also, if the system is to be used quite frequently, the addition of a receiver and some valves will speed up the operation.

All sorts of useful applications can be made of the air-hydraulic booster. By using a little imagination, one unit can be adapted to a dozen or more uses.

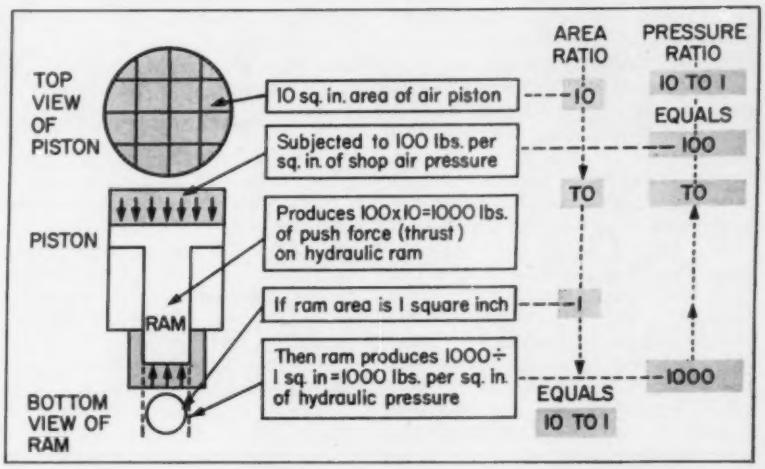


Fig. 1. Sketch shows principle of air-hydraulic boosters. Here, air pressure of 100 psi is converted to 1000-psi hydraulic pressure. Courtesy of Flick-Reedy Corp

Most significant feature of this device is the fact that extremely-high-pressure hydraulic power can be obtained from such a simple source as plant-pressure compressed air. In the *conventional hydraulic system*, an expensive and complicated pumping and valving arrangement is required.

On-the-job lifting and leveling of heavy power equipment can be performed with several boosters. Close position-control can be maintained by necessary throttling valves.

In power plant maintenance work, a simple job of lifting or pulling often requires a lot of rigging, or possibly the use of a crane — just to produce the necessary power required.

Also, space limitations often preclude the use of bulky mechanical equipment. These are the jobs where air-hydraulic boosters will be of most benefit.

On repetitive maintenance functions, where heavy power is required, a simple fixture or two can be made to adapt the booster to the work to be handled.

Men in charge of heavy power construction will find this device a very valuable and versatile addition to the standard kit of tools.

Complete information on air-hydraulic boosters, together with installation drawings, list of accessory equipment, and data on work-cylinders is available. Write the Editor, or jot Air-Hydraulic Boosters on enclosed Inquiry Card. THE END

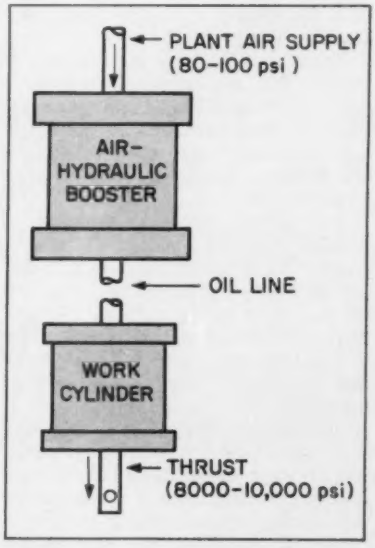
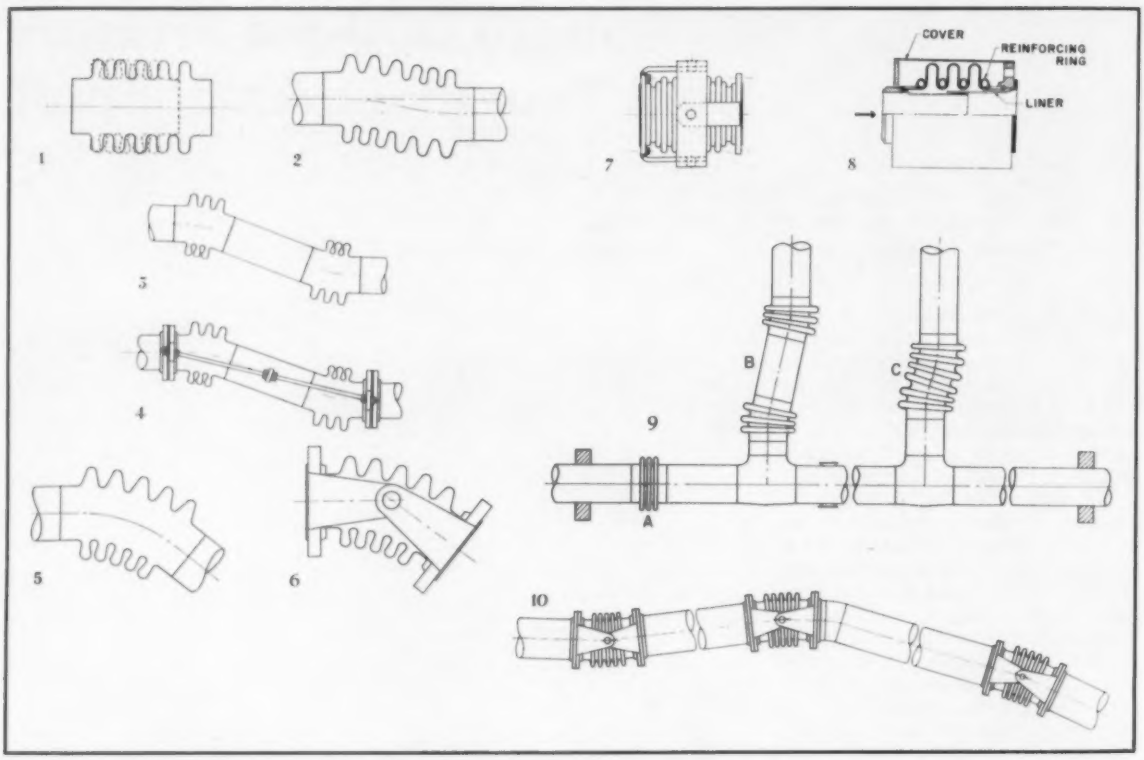


Fig. 2. Basic connections for converting air supply into hydraulic pressure



Figs. 1–10. Different configurations referred to in text. For illustrative purposes, extent of motion has been exaggerated

What Expansion Joints Can Do for You

Properly selected expansion joints can work wonders in providing piping system flexibility. Here's how to specify them correctly

By EDWARD F. HARRINGTON*

MAKING PROPER allowances for piping expansion and contraction is one of the most difficult problems confronting the piping engineer. Without adequate provision for absorbing dimensional changes, the resulting thrusts and moments are likely to impose excessive stresses on the line itself, or damage connected equipment.

Possibility of such malfunction is usually avoided by use of conventional loops, offsets, and other pipe configurations that permit the line to act like a spring in flexure or torsion, or by the inclusion of expansion joints that mechanically compensate for thermally created changes in length.

It should be emphasized that bellows expansion joints are not a panacea for poor piping layout. They are a highly specialized piece of equipment for solving difficult piping problems.

A few examples will help clarify the why and where of using bellows expansion joints. They are used:

1. Where restricted space makes it uneconomical or impossible to install expansion loops to absorb pipe expansion and contraction.

2. Where short piping runs connect process equipment.

3. Where piping for certain fluid catalytic processes rely on the thermal head to keep the fluid moving, and require short, straight runs to hold pressure drop to a minimum.

4. Where large pipe sizes would require such large loops or offsets to provide flexibility that they might impose unusual problems of cost, space, and support.

5. Where unusual cost situations exist, such as those where expensive alloy piping material is involved.

Bellows expansion joints require expert engineering and careful manufacturing if they are to perform satisfactorily. To apply a bellows joint successfully, one must recognize the design factors involved and make proper allowances for each in selecting the type to be used. Consideration must be given to:

Pipe: size, material, weight or schedule number.

Flowing medium: nature (liquid, gas, solids in suspension, corrosive, erosive, clogging tendency) and velocity.

External environment: exposure to corrosive or erosive atmosphere, wind load, weathering requirements, and the like.

Pressure: external or internal, constant, pulsating, shock.

Temperature: maximum, minimum, normal.

Vibration: direction, amplitude, frequency.

Location: length of straight pipe between pipe and anchors, proximity to valves or branch take-offs, adjacent equipment, and the like.

Thrust: spring force, hydrostatic end thrust; flow forces, guide friction.

* Tube Turns Div of Chemetron Corp

Motion: axial, offset, angular or a combination.

Expected life: number of anticipated cycles of full traverse and of lesser movements.

Special considerations: non-standard materials to be used, tests, limiting devices, and the like.

It is particularly important that the actual normal conditions of the piping installation for which a bellows joint is required be known, in order that the most satisfactory design may be developed. Assume, for example, a central-heating distribution system which is normally shut down once a year for the summer, but in which steam pressure is reduced over the weekend during heating season. Correct design is to consider both the extreme traverse, and also the more frequent lesser movements.

Nature, amount, and frequency of movement to be accommodated by a bellows expansion joint are key factors to be considered in selecting the best design for a specific installation. Each type of action normally encountered will be discussed.

Axial traverse is dimensional lengthening or shortening of the bellows joint parallel to its axis. During axial movement, faces of the joint remain perpendicular to the neutral center line. Bellows joint absorbing axial movement resembles an accordion; it opens or closes a predetermined distance in a straight line, Fig. 1. Such movement is measured in inches or fractions of an inch. Sum of compression and extension is of primary interest, and extension distance determines amount of pre-compression required where the bellows joint is to be installed above its lowest operating temperature.

Offset or lateral action is the movement of one end with respect to the other in a direction perpendicular to the initial longitudinal axis, Fig. 2. During offset motion, one end of the bellows is displaced from the neutral center line, but the faces remain perpendicular to that line, and connected pipes remain parallel to each other. This deflection results in unequal movement distribution over the bellows, since one portion contracts as the other expands.

There is apt to be some offset movement in any piping system. It is next to impossible to provide perfect alignment of pipe, pumps, supports, guides, and the like. Likewise, the piping may be connected to a metal tower or tank that tends to expand vertically, causing further misalignment. If the magnitude is slight, this lateral movement can be accommodated along with axial motion by a single bellows joint. If it is significant, it requires special consideration in design and addition of one or more convolutions to the bellows element.

It is sometimes desirable to employ a design specifically engineered to absorb offset motion. Examples are where there is considerable lateral deflection, where it is advisable to limit the number of convolutions in a single joint, or where forces transmitted to connected equipment are critical. This often may be accomplished best by use of a double expansion joint comprised of two bellows joined to a common connector, Fig. 3. Where pressure is significantly above atmospheric, the joint must be tied or otherwise restrained, Fig. 4.

Some Special Applications Used

Angular displacement is that resulting from movement of the longitudinal axis out of the original straight line position. In angular movement, one end is rotated with respect to the other about an axis transverse to the pipe axis, Fig. 5. Angular movement should not be confused with torsional rotation about the longitudinal axis of a joint, which must be avoided. Angular movement is measured in degrees.

Precisely speaking, angular rotation connotes a constant bending moment with each convolution rotating through the same angle. Thus, true angular rotation takes place only when the expansion joint is restricted to rotational movement about a central point by hinges or similar devices pivoted at a point midway between the two ends of the assembly, as shown by Fig. 6.

Use of a single-hinged bellows joint could result in appreciable bending to connected pipe, often producing stresses beyond allowable design limits. Hence, when angular rotation is present, hinged joints are often used in pairs or sets of three.

Where rotation in more than one plane is involved, a compound rotation (or so-called gimbal) joint is useful, Fig. 7. Combinations of axial, angular, and offset movement can be absorbed by specially designed universal joints. Like other uncontrolled or semi-controlled flexible connectors, they should ordinarily be limited to low-pressure, non-critical usage.

With its entry into the bellows expansion joint market, Tube Turns utilized its extensive research and testing facilities to introduce a new concept: realistic test ratings based on minimum rather than average or maximum cyclic life.

These ratings are predicated on data obtained from a large number of tests designed to permit a comprehensive evaluation of the interrelation of traverse, pressure, and cyclic life. Results of cyclic axial-traverse tests have been carefully correlated by means of rationally-based formulas, and it is possible to predict the minimum number of cycles to failure.

This rating concept, backed by experimental evidence, should resolve the doubts of those power engineers who have been reluctant to specify bellows expansion joints because of previous adverse experience with them. THE END

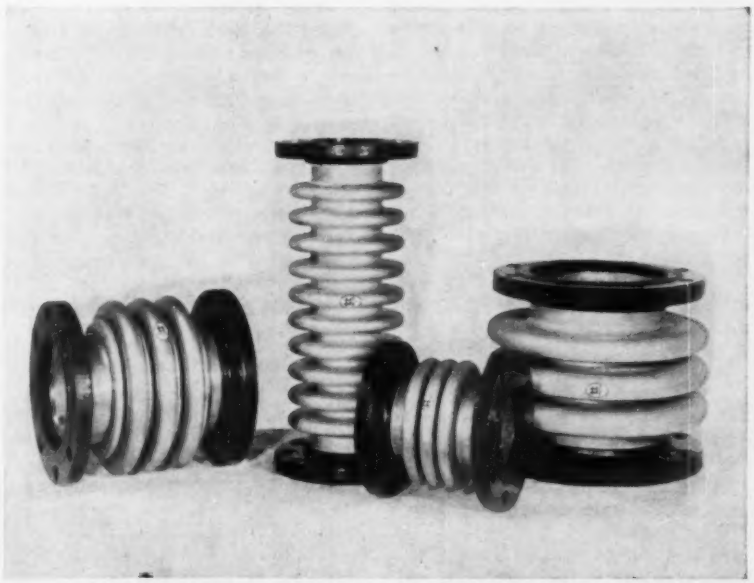


Fig. 11. Typical bellows-type expansion joints shown here are stainless steel and serve applications having temperatures up to 750 F, pressures to 300 psi

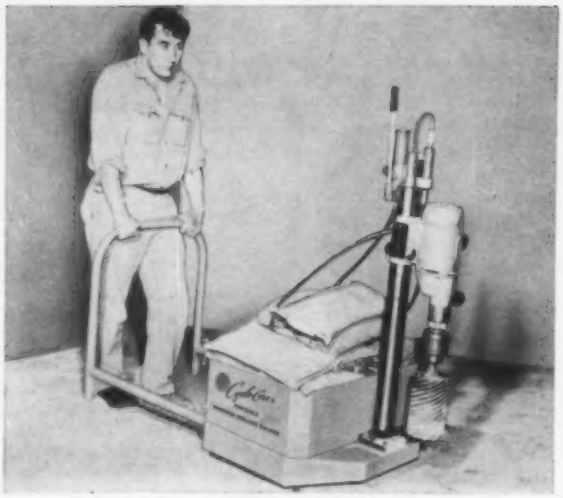


Fig. 1. Photo of portable high-thrust carbide-tool drilling machine, being balanced by one man, shows easy mobility

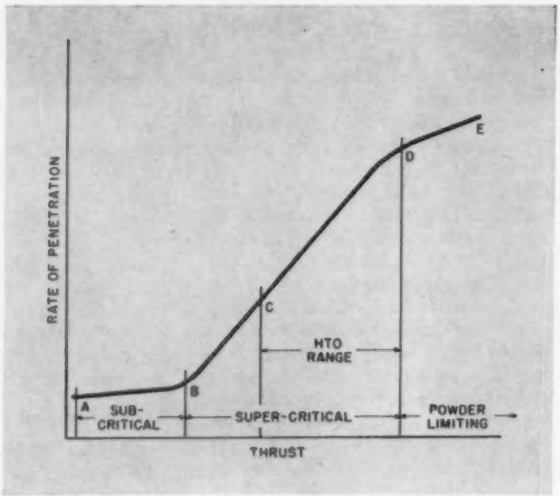


Fig. 2. Graph shows relation between thrust and rate of penetration. Area between C and D is most effective range

Another Power Tool—

New Idea in Masonry Drilling

Necessity for noisy, unsatisfactory impact-cutting of masonry has been eliminated with carbide-tipped rotary cutting bits. However, this method had been slow and costly, until new high-thrust technique was developed; is particularly useful in occupied buildings

By B. L. CHAPIN *

IN THE PAST several years, intensive development programs have been conducted to provide means of drilling masonry, on the job, at the lowest possible cost. Tungsten carbide-tipped rotary masonry bits have been well-established as an ideal means of achieving this end. In addition to their low initial and reconditioning costs, the carbide-tipped bits offer the desirable capability of drilling without water.

Although long strides have been made in creating the best designs for carbide-tipped masonry bits, one of the most important achievements has been the introduction of a laboratory concept into the field.

Primary advance in masonry drilling on construction jobs, in recent months, has been made by operation in the *high-thrust range*. The transfer of this laboratory concept, onto the job, has been made possible by the development of special machines. These portable, high-thrust producers have utilized free-cutting masonry bits of rugged construction, capable of sustained operation at high drilling rates.

High-thrust operation (HTO) has brought about a difference in attitude to such materials as hard, reinforced concrete, long considered one of the most difficult materials to drill. Dry drilling of reinforced concrete has become a matter of routine when one is equipped with a good machine capable of HTO, and a rugged, free-cutting, carbide-tipped masonry bit.

Range of hole sizes that can be drilled has been increased to diameters of 8 in. and over. The rates of penetration at which these units operate are extremely high, compared to drilling rates previously attained on the job. And no water is required.

A typical machine capable of HTO is shown in Fig. 1, equipped with a carbide-tipped core bit, 6 in. in diameter. By means of this rigid, stable machine, with the accurate control of thrust which it affords, HTO makes economical hole-drilling possible in the "impossible" materials.

Material Properties

When drilling masonry, certain properties of the material being drilled must be considered for their effects on the results to be expected.

Material properties which affect the drilling process to the greatest extent are: 1. Hardness; 2. abrasiveness; 3. homogeneity; 4. powder bulk.

Stated in basic terms, a cutting tip cuts when two forces are applied at the cutting edge. These forces are: 1. Axial Force (this force acts to push the tip into the material): Called the *thrust*, it regulates the size of the "bite" taken by the bit; and 2. torsional force, which acts to turn the bit, moving the tip through the material, and thereby doing most of the work of cutting.

The torsional force is supplied by the motor. The thrust, ordinarily supplied by the pushing and straining of an operator, is supplied and maintained at the proper level by the machine during HTO.

The paradox is that, although the torsional forces do most of the work, the entire operation is most sensitive to the thrust. Additionally, until the advent of the HTO machines, no adequate means of applying thrust (at the proper level) was available.

Effect of thrust on the rate of penetration of a typical bit is shown in Fig. 2. From the curve it is apparent that the rate of pentration is little affected until the thrust level is raised to a relatively high value.

As the thrust is increased, the critical zone is reached, and penetration of the material by the tip is accomplished. As additional thrust is ap-

* President, New England Carbide Tool Co, Inc

plied, the supercritical zone is reached and the cutting action begins. With increasing thrust, larger and larger "bites" of the material are made by the tip. The further into the supercritical region one operates, the more favorable the results become. A smaller proportion of the power is used wastefully in heat generation.

A limitation to the extent to which thrust may be increased with worthwhile results does exist. As thrust is increased to still higher values, the rate of penetration again will be little affected by new increments of thrust. In this very high thrust range (portion D-E of the curve in Fig. 2) powder removal becomes the controlling factor. As powder is produced in volume, a larger proportion of power supplied to the bit is used in powder removal and in wasteful regrinding of powder already produced.

Thrust level at which the powder removal limitation becomes evident depends on the type of bit used. A free-cutting bit, with adequate provision for expansion of the powder as it is formed, and with high-flute carrying capacity, should be used during HTO.

Serious difficulties, associated with the drilling of non-homogeneous materials like reinforced concrete, are axial vibration, chatter, and impact. Consider a cutting tip operating with *low thrust* as it encounters a piece of aggregate. The tip will have a tendency to ride up and over the harder material.

As this action is repeated over numerous pieces of aggregate and rod, serious vibration can occur. In some instances, the bit begins to bounce as the amplitude of these vibrations increases. The result is badly battered tips. Part of the solution to this part of the problem is increased thrust to counteract this occurrence.

High thrust alone, unfortunately, is not the entire solution to the problem. This is because, as the tip encounters the inclined surface of a piece of aggregate (or a piece of rod), a portion of the torsional force is diverted to counteract the thrust; the bit tends to be pushed out of the hole.

Complete solution to this problem lies in the combination of HTO and a well-designed, rigid machine. The importance of the design and construction of the machine cannot be overstressed when drilling in reinforced concrete.

Design Requirements

Importance of HTO, in drilling holes economically in materials such as reinforced concrete, has been well established. The problem involved in bringing HTO onto the job is to incorporate the capability of developing the required thrust — in a machine that's easily handled. At the same time, the machine must be so constructed as to transmit thrust to a bit through as rigid a system as possible.

Portable HTO machines may be classified in accordance with the methods by which they produce thrust: 1. By gravity, through the application of weights; and, 2., by reaction, against fixed members of a building or other structure. In the first method of thrust production, weight distribution plays an important part. The design of the machine must be such that its center of gravity, when loaded, bears proper relationship to the bit and the points of support of the machine.

At the same time, the weight should be so distributed that moving the machine from one location to another may be accomplished with ease. The machine shown in Fig. 1 is loaded with sufficient weight to produce thrust in excess of 1000 lb; however, it may be moved about by one man.

Weights used for the machine in Fig. 1 are bags filled with a dense, inert material. The material also serves to absorb a great deal of the harmful vibration previously discussed. As has been reiterated, in addition to supplying the thrust at the bit, a good HTO machine must be so constructed as to limit the amplitude of the axial vibration associated with the drilling of non-homogeneous materials.

By proper design, a machine depending on gravity for the production of thrust may be utilized for horizontal drilling. Figure 1 shows the machine already converted for horizontal drilling. Horizontal thrust can reach values as high as those achieved in vertical drilling in well-designed machines. In horizontal drilling it is important to obtain a high coefficient of friction between the machine and the floor. A piece of scrap lumber best serves this purpose.

An additional factor which must be considered in HTO is control of the thrust. The machine shown has a rack and pinion which permits sensitive control by the operator. Thrust is easily maintained at the proper level by the "feel" of the operation.

For more information, write the Editor, or jot Masonry Drilling on the enclosed Inquiry Card. THE END

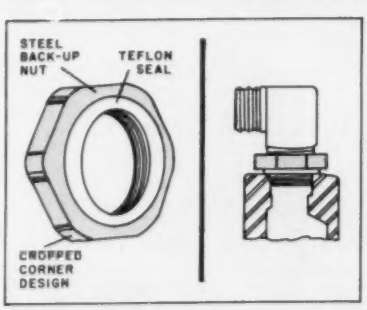
New Device Seals Pipe Fittings in All Positions

UNTIL quite recently, the installation of piping involved one common problem. Trying to get leak-tight joints, at all fittings, had been a piping headache for years.

This was especially true in those situations where an angle fitting had to be wrench-tight, yet have the outlet facing in a certain direction. In such cases, it was usually necessary to loosen or over-tighten the fitting to get a tight seal.

Also, due to poor threading, some pipe joints just wouldn't stop leaking. Of course, pipe "dope" has been of great help in this condition; however, it is not the complete answer to the problem.

Now there's a simple but most effective seal which solves practically all of the problems mentioned. This device is a specially-constructed steel



nut, which has a built-in Teflon seal washer.

All that's required to apply this new seal is: 1. Apply the seal-nut to the male end of pipe or fitting; then run it up to a hand-tight fit; 2. pipe, or fitting, is run into the female opening of the companion fitting or equipment — to a hand-tight fit; 3. pipe (or fitting) is positioned in right direction; and 4. seal-fitting is tightened with a wrench.

New seal-fitting is known as TRU-SEAL; it is produced in all sizes from ⅛ to 2½ in., requires no pipe dope, can be reused, is corrosion-resistant, and is effective at a wide range of temperatures and pressures.

Device is particularly valuable in tight locations, where standard wrenches cannot be used, and also in instrument piping, where many angle fittings must be installed in close quarters.

Illustration shows details of a Tru-Seal, and its application to a fitting connection. If you would like more information, write the Editor, or jot Tru-Seal on the enclosed Inquiry Card, page 109.

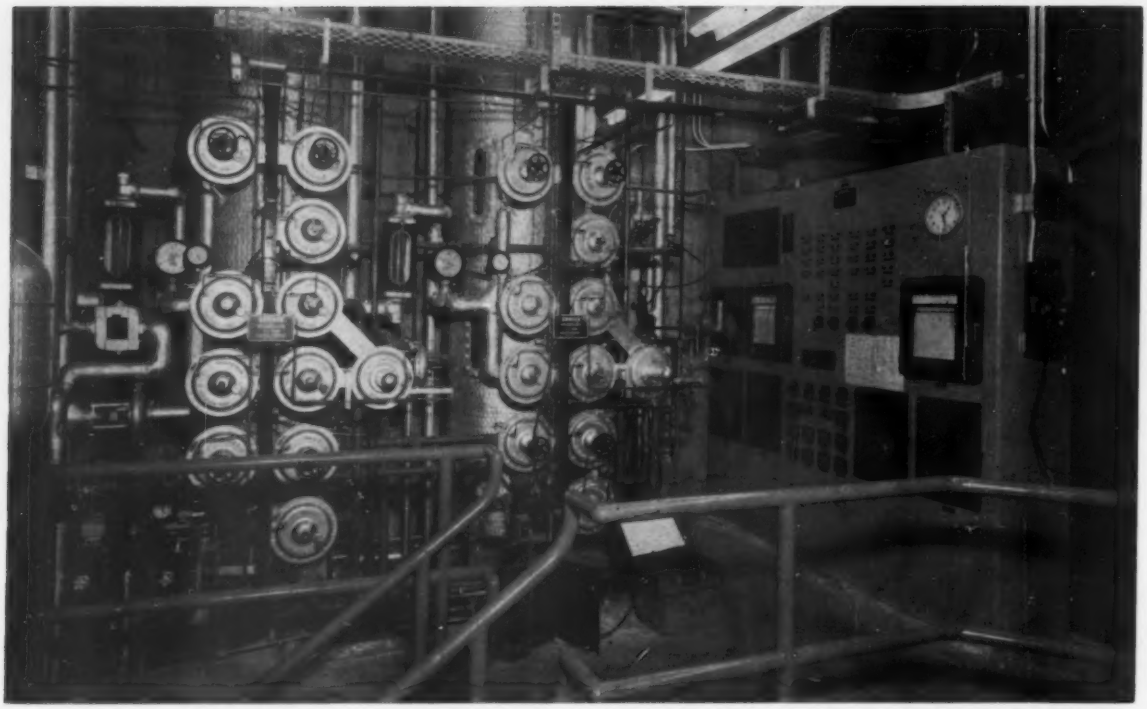


Fig. 1. This automatic mixed-bed demineralizer will process boiler feedwater for Louisiana Power's Little Gypsy Station

What Condensate Scavenging Will Do At Little Gypsy Station

Need for exceptional reliability of all components in today's automatic power plants extends particularly to boiler water conditioning. In addition, savings that will accrue to Little Gypsy from condensate scavenging will be of interest to all future stations

By DAVID SPILLANE *

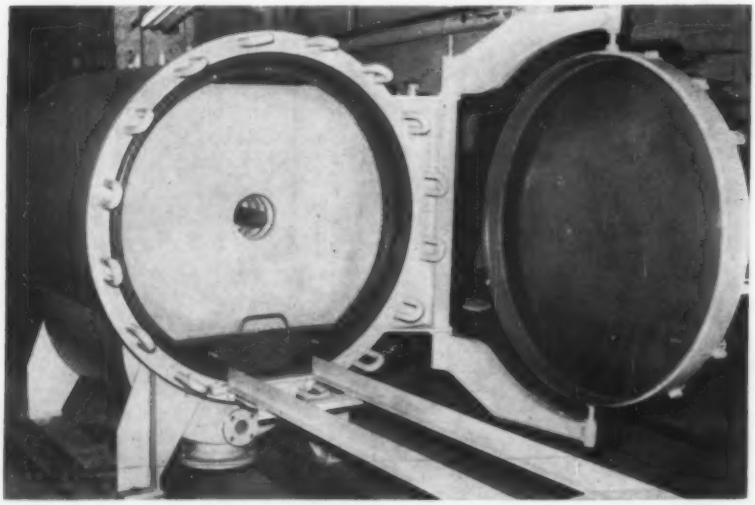


Fig. 2. Little Gypsy will use Graver-Davis condensate filters similar to these

NEED FOR condensate scavenging in nuclear, super-critical and high-pressure, once-through sub-critical power plants has been made amply apparent in the last few years. Much of the pioneering work needed to prove the value of scavenging was done by the author's company, and notably, V. J. Calise, general sales manager, and the author.

Graver, which has designed scavenging systems for each type of plant mentioned above, will now supply the first such system for a drum-type, sub-critical central station, Little Gypsy Station of Louisiana Power and Light Co.

Economic breakdown of costs and savings which determined purchase of the system shows that condensate

* Power Plant Utilities Manager, Graver Water Conditioning Co

Why This Article

Automation of power facilities places emphasis more than ever on reliability and economy. Condensate scavenging is one of the resulting economies that is destined to become a standard power practice.

scavenging can actually be more economical for a drum-type station than makeup treatment alone, and can produce an operating savings over and above the savings required to amortize the equipment.

First economy a scavenging system allows is the design of a much simpler, and therefore less costly makeup treatment plant producing somewhat less pure demineralized water. Main item of operating savings, however, is thermal efficiency, followed by savings on blowdown heat, increased boiler availability, reduced outages and maintenance, faster start-up and restarts, and a guarantee of no silica leakage. At Little Gypsy, these economies are expected to give an actual savings of over $10,000 yearly.

Low maintenance and reduced outages are particularly important at Little Gypsy since the entire plant operation will be controlled by an electric computer handling a total of 800 different steps involved in start-up and shutdown. For this reason, maximum reliability is required for all phases of plant operation. The scavengers are expected to contribute materially to this reliability.

Vital statistics on Little Gypsy are that it will be a gas-fired, 230,000-kw electric generating station operating at 2400 psi and 1000 F. Condensate scavenging equipment will consist of three mixed-bed demineralizers and two Graver-Davis Leaf-type Condensate Filters. Equipment will be shipped early this year, and the plant is expected to go on the line in early 1961.

Economic breakdown in table, A and B, I, II and III, shows what the cost of a water treatment plant for Little Gypsy would be with, and without, condensate scavenging. It also includes the projected savings with scavenging and the advantages of using the system.

While Little Gypsy inaugurates a new departure in central station practice, it is felt that most of the utilities and central station plants in the country will wish to consider carefully both economic and technical advantages of high-rate condensate scavenging for all new power plant cycles of 1800 psi and over. THE END

Table of economic analysis justifying condensate scavenging at Little Gypsy

A. Cost of Makeup Treatment Without Scavenging

I. Equipment Cost
1. Reactivator clarifier, feeds, sand filters
2. Graver-Davis Leaf Filter, ahead of makeup demineralizer
3. Makeup demineralizer—assembled and skid-mounted

Approximate Installed Cost $203,000

II. Chemical Cost

Alum or $FeCl_3$ at 4¢/#	1.16	
Caustic, 50% at 4¢/#	.40	
	1.56¢/M gals	
Acid, 6.86 #/M gal at 1.5¢/#	10.06	
Caustic, 6.85 #/M gal at 4¢/#	27.40	
	37.46¢/M gals	
	Total	39.02¢/M gals

III. Annual Evaluated Cost

Equipment (annual charges for return, depreciation and taxes)	$21,315
Chemical Cost (based on 46,000,000 gal/yr makeup)	18,000
Labor	9,000
Total Costs per year	$48,315

B. Cost of Simplified Makeup Treatment Plus Full Flow 3000 gpm High Rate Condensate Scavenging System

I. Equipment Cost
1. Reactivator clarifier, chemical feeds, Graver automatic valveless filters
2. Semi-automatic makeup demineralizer—shop assembled and skid-mounted (1–2 micromhos effluent purity guaranteed)
3. Graver-Davis Leaf Filters on 100% condensate
4. Condensate demineralizers
   2—units equipped for external resin regeneration (average flow rate—30 gpm/sq ft)
   1—complete instrumentation involving 4 pt conductivity recorder, flow recorders, alarm lights and control cubicle

Approximate Installed Cost $388,000

II. Chemical Cost

Makeup	38.27¢/M gal
Condensate Units	$3/day

III. Annual Evaluated Cost

Equipment (annual charges for return, depreciation and taxes)	$ 40,740
Chemical Cost (based on 31,000,000 gal/yr makeup)	12,000
Labor	9,500
Total Cost per year	$ 62,240

C. Justification of Condensate Scavenging

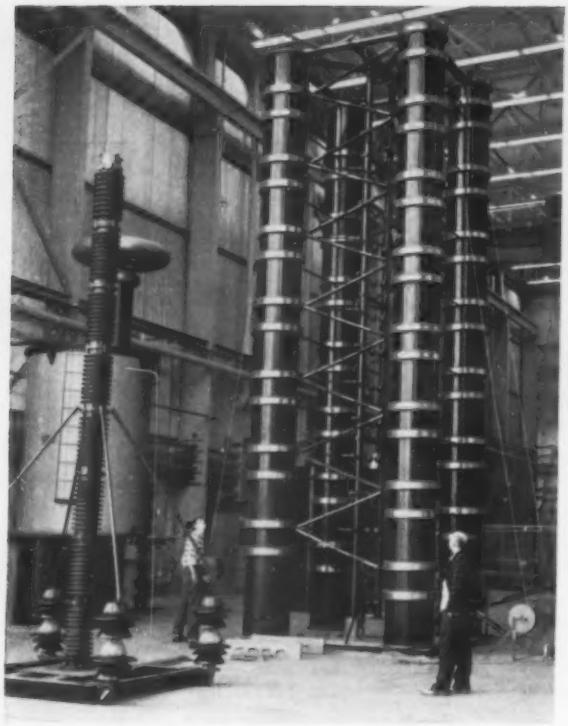
The difference in cost between condensate scavenging and simplified makeup demineralizing vs the more complicated makeup demineralizer and no condensate scavenger amounted to $13,925 as shown below:

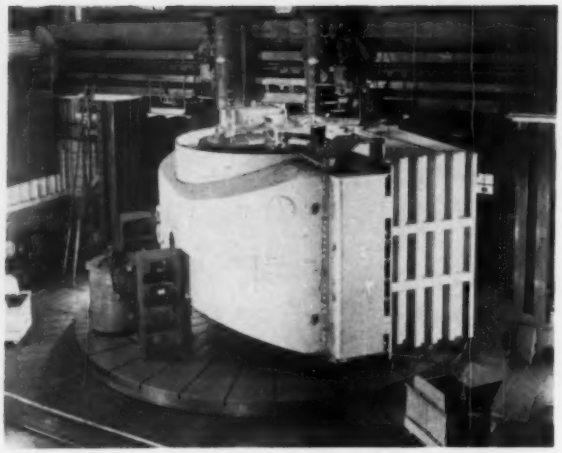
Condensate scavenging and simple 2 bed makeup demineralizing (somewhat less pure makeup quality)	$ 62,240
More expensive makeup demineralizing producing very pure makeup and no condensate scavenging	$ 48,315
Added Cost for Condensate Scavenging	$ 13,925

This added amount of $13,925 for condensate scavenging was offset by the following considerations:

1. Over-all thermal efficiency gain of 0.3% (mainly due to turbine blades and all internal surfaces being cleaner) and use of higher load factor	$ 13,000/yr
2. Reduced boiler blowdown heat gain	1,000/yr
3. Gain from increased boiler availability	$ 2,000/yr
4. Gain from reduced outages over 2–3 year period	$ 2,000/yr
5. Gain from reduced maintenance	$ 1,500/yr
6. Gain from faster start-up to higher load factor (due to removal of TDS and Fe and Cu in feedwater system from the very start with filtration and condensate scavenging and start-up savings of 4–6 weeks normally required to get TDS and silica down from zero start by rinsing and blowdown at lower load operation)	$ 2,200/yr
7. Guarantee of no silica leakage from condenser tube leakage or weepage with high turbidity siliceous clay in the cooling water	$ 2,600/yr
Total gains from Condensate Scavenging (Approximate)	$ 24,300/yr
Added cost for Condensate Scavenging Equipment	$ 13,925/yr
On this basis, condensate scavenging showed a savings of.....	$ 10,375/yr

and gave absolute assurance of higher load operations, freedom from outages and minimum labor or attention for boiler plant from internal cycle point of view.





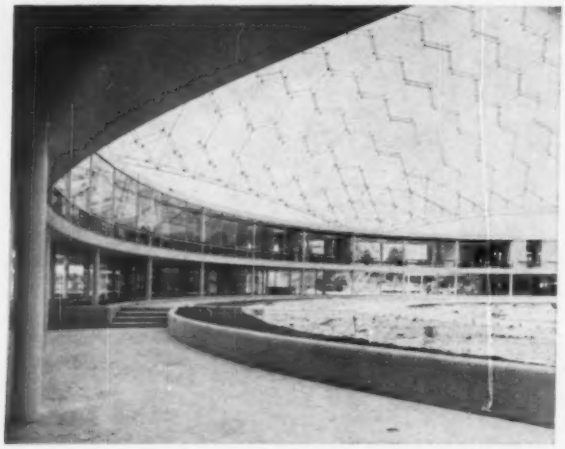
Huge section of a low-pressure turbine for a 340-Mw 3600/1800-rpm cross-compound steam turbine-generator unit shown here being machined on a 40-ft mill at Allis-Chalmers. Unit is No. 4 at Consolidated Edison's Astoria station in N. Y. Conditions are 2000 psig, 1050/1000 F

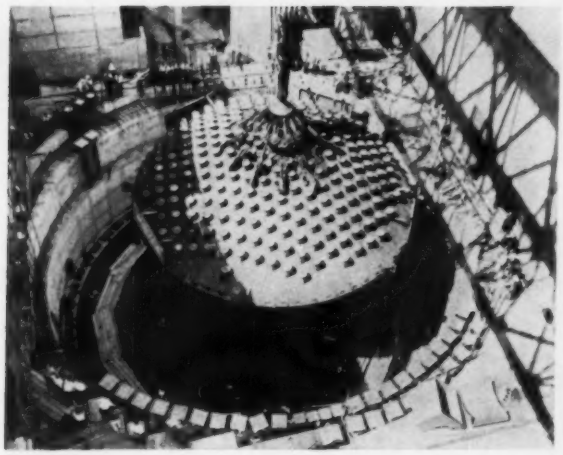
Impulse generator is prepared for test use at GE's new million-dollar high voltage switchgear testing laboratory in Philadelphia. In foreground is shaping capacitor that determines rate of rise of surge from impulse generator to circuit breaker under test. Maximum charge is 3,000,000 v

POWER ENGINEERING'S

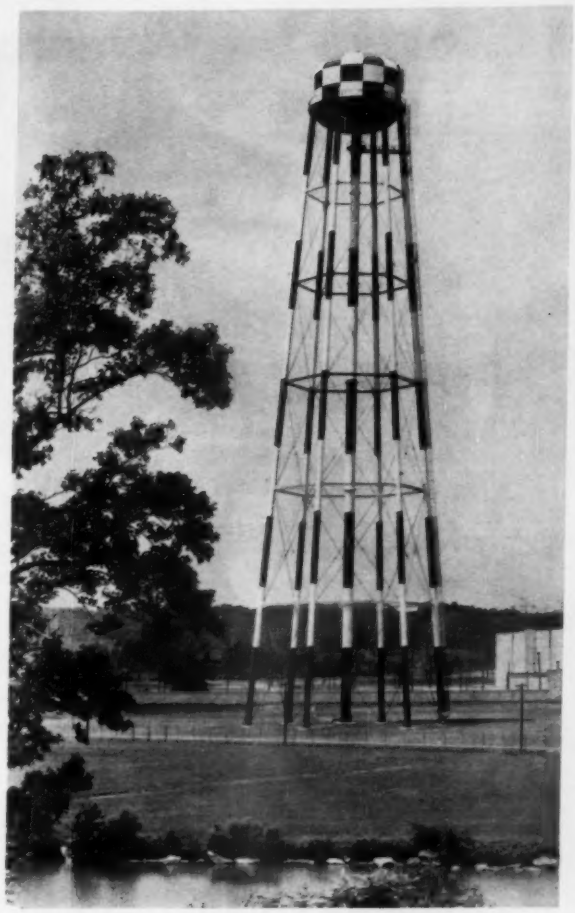
Nuclear fuel elements being readied by Westinghouse for use in Belgium's first atomic power plant. Completed reactor core will consist of 32 fuel elements each with a total of 110 tubes containing pellets of uranium oxide. The 11,500-kw plant is scheduled to begin operation in Sept, at Mol

New home of the American Society for Metals near Cleveland is this unique, semi-circular, 3-level structure dominated by an open-work geodesic aluminum dome rising 10 stories and measuring 250 ft across. It was designed by R. Buckminster Fuller. This is view of building's inner court and dome





Top dome of Bradwell Nuclear Power Station's No. 1 reactor pressure vessel is lowered into position. This plant, in Essex, England, is one of a dozen or more which will be producing some 5000–6000 Mw for Britain by 1966. This steel dome weighs 200 tons, is 47 ft in diam and 4 in. thick



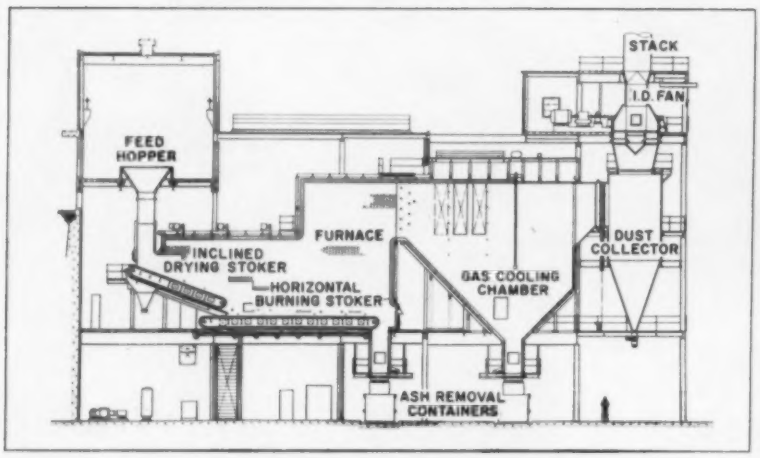
Tallest tank. Rising some 365 ft above the ground, this water storage tank is believed to be the tallest in the U. S. Built by Chicago Bridge & Iron Co, it stores 400,000 gal of water for fire protection at the AEC's uranium production plant at Oak Ridge, Tenn. Checkerboard paint helps visibility

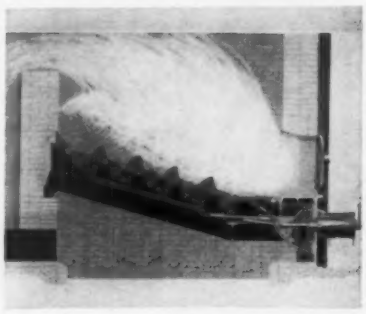
NEWS REEL

Linking Europe and Asia for the first time by aerial power transmission line is this project being carried out on the Bosporus for Turkey by Stone & Webster. Span is 5246 ft, steel towers are 371 ft high. (L to r) R. P. Eakins and W. L. Sheets of S&W, Niyazi Yildirim of Turkish group

140,000-kw addition to the Danskammer Point power plant of Central Hudson Gas & Electric, on the Hudson near Newburgh, N. Y., doubles plant's generating capacity. Cost of addition was about $26,500,000. Central Hudson's electric sales have increased 60% since station opened in 1951

Stokers for Incinerators . . . New Trend to





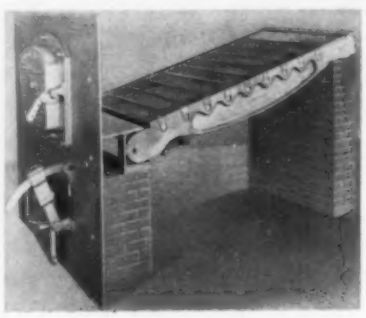


Fig. 1. Traveling grate stokers in Philadelphia's 600-ton Northwest incinerator plant. Waste is pre-dried and partially burned on inclined drying stoker. Horizontal stoker completes combustion process. Fig. 2 (above). Recently introduced hydraulically-driven incinerator stoker achieves progressive burning on alternately rising stoker bars which break chunks apart and thrust the fuel forward. Fig. 3 (right). Inclined rocking grate, including furnace front, moves the waste gradually forward to the ash dumping stage

By JOHN H. D. BLANKE*

INTERESTING NEW TREND in design of incinerator furnaces is the application of traveling grate stokers. Essentially an installation consists of a drying stoker inclined about 25 deg which drops the refuse about 2½ ft to a horizontal burning stoker. Each stoker is chain-driven by an electric motor. Stoker speed is controlled manually, and the burning stoker is traveled at a higher speed to obtain a thinner layer of refuse.

The drying stoker is charged through a self-sealing and non-clogging type of chute. Delivery of refuse is uniform and continuous. Dampers underneath the stokers afford zone control of pressure and volume of air for drying and burning. Owing to heat radiation from the burning stoker, the drying stoker is protected by water cooling, and by forced draft at the lower end. The burning stoker may be operated with air preheated to 400 F.

The City of New York is said to have installed the first large-scale traveling grate stoker in an incinerator. Philadelphia's incinerator construction program has called for the installation of traveling grate stokers in the two 300-ton furnaces of the 600-ton Northwest incinerator. The two stacks for the Northwest plant are short, the furnace gases being passed through fly ash eliminators of the water-spray, gas-scrubber type, with induced draft supplied by fans.

In the New York installations, all furnaces are equipped with multi-unit dust collectors of small diameter. Since large fans for induced draft are required with these filters, standard-type fans are used, and they are provided with air-cooling and water-cooling chambers as a protection of fan parts against damage by hot flue gases.

With the traveling grate stokers, the rate of waste incineration is adjusted to the consistency or general character of the incoming fuel. Control of the burning rate of the refuse by variation of individual stoker speed is regarded as one of the major factors in the achieved reduction of fly ash emission from the stack. With sealed-in furnace operation effected through refuse-sealed charging chute and water-sealed ash discharge gate, the combustion of refuse is maintained at a rather constant temperature.

To achieve maximum incineration of refuse, the burning stoker is made longer than the drying stoker. This permits thinning of the fuel bed and longer time for the fuel on the grate.

Burning rate of the traveling grate stoker is better than 70 lb of refuse per hour per sq ft of the combined gross effective grate area of both the drying and the burning stokers.

Rocking Grate Stoker

The rocking grate stoker, set at an incline of about 15 deg, effects progressive burning of waste by upward movement of alternate hydraulically-actuated stoker bars. Designed for use in engineered incinerators ranging in capacity from 35 tons to 1200 tons, this stoker has found wide acceptance by municipalities, institutions and industries.

From 1951 to 1958, rocking grate stokers aggregating more than 17,500 tons of incinerator capacity were placed by one manufacturer in engineered plants. Smallest stoker in the group has a grate area of only 25 sq ft, and the largest single stoker has a grate area of 588 sq ft and is burning more than 500 tons of refuse per day.

In an alternate design, the rocking grate stoker is installed in tandem. Both stokers are placed in sloped position, the first serving as a drying and partial burning stoker and the second as the full burning stoker.

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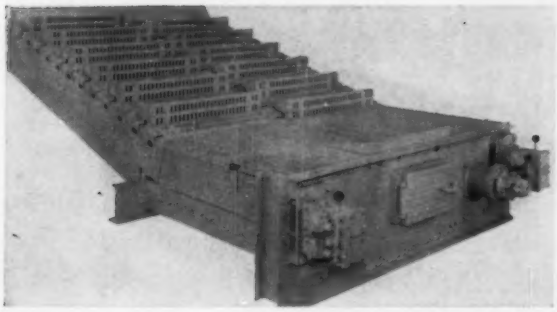
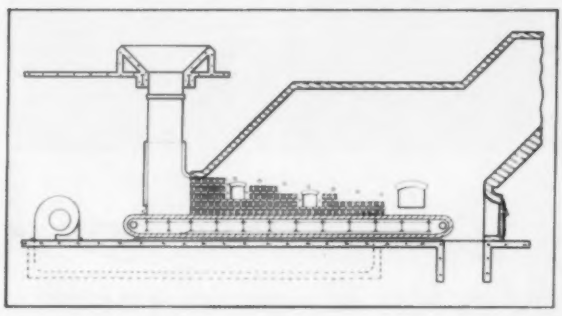
* Technical writer. Member of Western Society of Engineers

Traveling Grates





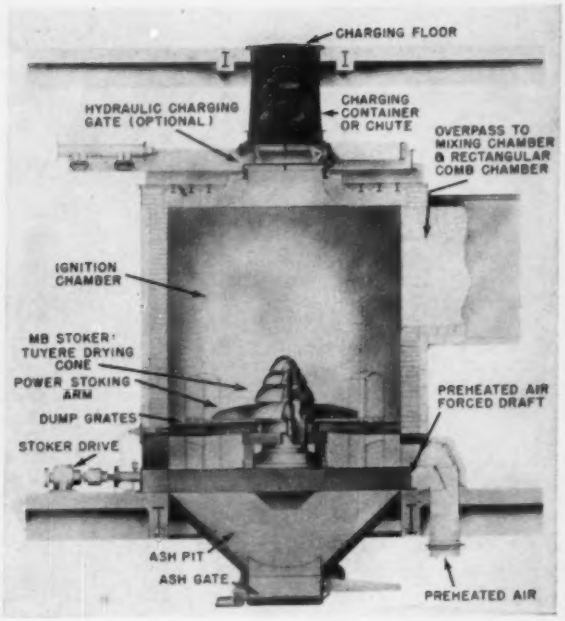


Fig. 4. (above, left). Slightly inclined hydraulically-operated grate stoker designed to burn 60 lb of refuse per sq ft per hour. Alternate sets of grate bars rise and lower burning mass. Fig. 5 (left). Single traveling grate stoker intended for use in smaller sizes. Both drying and burning are done on one grate. Fig. 6. Circular unit with coned rotating arm stoker

Chamber is provided under each stoker for siftings through the grate; but the ash-dumping plate is at the low end of the burning stoker in customary design. Timing of rocking of both stokers is separately controlled for optimum drying and burning effect.

Rotating Arm Cone Stoker

Among the bigger community incinerators with rotating arm stokers are the 900-ton plant at Miami, Fla, which has six 150-ton furnaces, and the 700-ton plant at Hempstead, N. Y., with four 175-ton furnaces.

Furnace which contains the rotating arm stoker is of vertical cylindrical design. Refuse may be charged at the top or at the side of the furnace, depending on plant design. In the side-charging design, the combustion chamber is above the ignition chamber, but in the top-charging design the combustion chamber is at the side.

Furnace with rotating arm stoker was designed to supply air for combustion uniformly in regulated quantities, to avoid blow holes in the fuel bed, and to minimize use of excess air. For capacities of 60 tons per day and upward, the furnace is designed with building and stack; but for capacities from 50 tons down to 20 tons, a vertical incinerator without building is available.

Revolving cone and rotating arms of the stoker raise and lower gently, agitate the fuel, and move the burning mass slowly and automatically to the annular ring of dumping grates. Leading face of the rotating arms is adjustable for control of lift and outward motion of the burning refuse. Forced draft applied through orifices from beneath cools the cone and arms which contain many air outlet holes.

Rotating Arm Tuyere Stoker

The 700-ton incinerator at Hempstead, N. Y., is an outstanding example of circular furnace design embodying utilization of heat from refuse. Fitted with rotating arm mechanical stokers, the four 175-ton vertical furnaces are each 17 ft, 4 in. in diameter. They deliver the gases produced in burning refuse in the ignition chamber to two combustion chambers. Generated heat of combustion is passed to a waste heat boiler which has capacity to make 120,000 lb of steam in 24 hours. The generated steam powers a water pumping station, two fan-boosted cyclone fly ash collectors, and other incinerator plant auxiliaries.

Incinerators using the rotating arm tuyere stoker range in total plant capacity from about 40 tons to 700 tons. The larger incinerators are utilized with furnaces of desired ton capacities. Each furnace consists of the conical-shaped stoker mechanism with tuyere-type drying cone and revolving stoker arms mounted within a vertical cylindrical brick lining that functions as an ignition and burning chamber, and is contained in a steel casting. Final burning grate is on the periphery of the revolving stoker.

Refuse is charged manually or by crane or bulldozer through a chute at the top of the furnace. Chute is sealed off by a gate that may be operated by hand or hydraulically. Gases produced by ignition and burning of refuse pass to an adjoining circular or rectangular combustion chamber. As burning of combustibles is completed, the gases continue to an expansion chamber and through flues to the stack or waste heat boiler.

Preheated air is supplied by forced draft underneath the mechanical stoker. Ash is dumped off peripheral plates surrounding the stoker to a brick-lined steel ash hopper for quenching and disposal. THE END

Acknowledgements: Fig. 1, Combustion Engineering. Fig. 2, Flynn & Emrich. Fig. 3, Canton Stoker Corporation. Fig. 4, American Engineering Co. Fig. 5, Combustion Engineering. Fig. 6, Morse-Boulger Destructor Co.

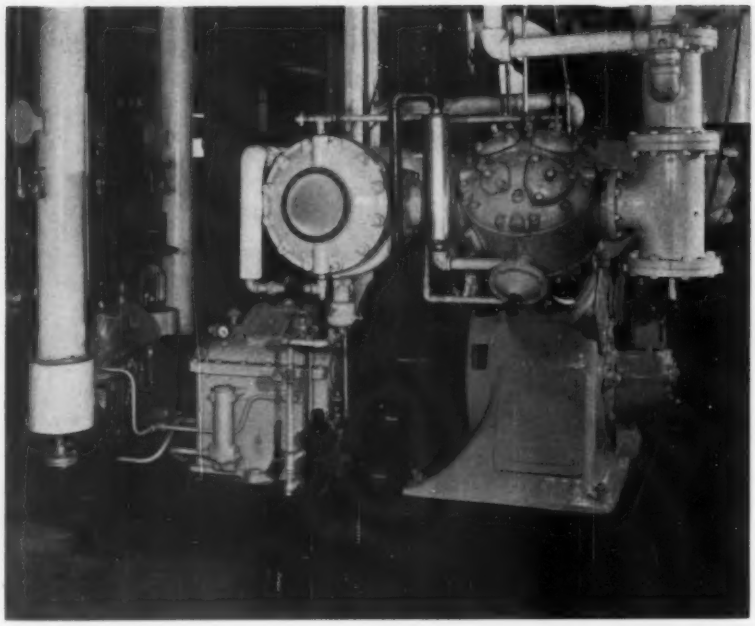


Fig. 1. Compressor driven by steam turbine. Exhaust steam is used in process

Recent articles in POWER ENGINEERING told how to specify compressors to fit specific service applications. Continuing that series, this article tells you how to . . .

Select Your Compressor Drives To Fit Service Requirements

PRINCIPAL types of prime movers used to drive compressors include those powered by electricity, gas, gasoline, oil, and steam. Portable units, because they are often used at sites without easy access to electricity, are usually driven by gasoline or diesel (oil) engines.

Steam is available for most types of double-acting compressors, with the steam engine either an integral part of the compressor or separated therefrom. Available types include simple cylinders for low steam pressure, and high back-pressure and compound cylinders for high steam pressures. Figure 1 shows a compressor with a steam turbine drive.

In electric drives, the squirrel-cage induction motor is commonly used for driving belted and high-speed, direct-coupled compressors of 125 hp and below. Occasionally, a synchronous motor is used. In the 60-100 hp range, the direct-connected synchronous motor drive is used for multi-cylinder, double-acting compressors. Compressor manufacturer should be consulted when electric drive is contemplated because of the questions of starting torque, starting current, and suitable flywheel effect. A compressor with a flange-mounted electric motor is shown in Figure 2.

Internal combustion engines (oil, gasoline, or gas) are most frequently used to drive stationary compressors where the cost of fuel is low or where other forms of power are not readily available. Small compressors may be driven by oil, gasoline, or gas, and larger sizes by oil or gas. Figure 3 is an illustration of a 300-psig unit, complete with diesel engine and radiator-type intercooler and compressor jacket-water cooler.

Selecting Driver Types

Among displacement-type compressors, the rotary compressor is usually coupled directly to an electric motor, gas or gasoline engine, or steam turbine or engine. Of the dynamic types, however, the centrifugal compressor — which is a high-speed machine — is usually driven by a direct-connected electric motor, through speed-reducing gears and an electric motor, or a direct-connected gas or steam turbine. Internal combustion engines are rarely used with the centrifugal unit because they require speed-increasing gears.

In most cases, selection of the driver type depends on the type of power available. Having selected the general type (electric, steam, or internal combustion), the kind of operation (speed, power requirements, cost of driver fuel, etc) will usually govern the variation, or rating, within the general type.

For example, squirrel-cage induction, or synchronous, motors are best suited for constant-speed operation of electric motor drives. Wound-motor induction, or direct-current motors are well adapted for variable speeds. Steam turbine drives are available for either constant-speed or variable-speed drive.

When it appears that a variable speed is required and special conditions indicate a constant-speed drive to be best, a variable-speed transmission (electric or hydraulic coupling) may be used to vary compressor speed so as to meet the variable-speed requirements.

When selecting an electric motor, consideration must be given to the starting and operating characteristics of the load, kva limitations of the electrical supply, power factor, temperature, altitude of the site, and speed and type (continuous or intermittent) service. The ideal electrical drive is the direct-connected motor, the speed of which, at 60 cps, is about 3600 rpm for either induction or two-pole synchronous motors. When a higher speed is required, speed-increasing gears are needed.

Among the steam-propelled drives, turbines for non-condensing operation are usually single-stage units, which have relatively high steam consumption. If low steam consump-

tion is desired, a multi-stage steam turbine which features condensing operation is used.

Until 1918, high-pressure air was universally used for the injection of fuel into a diesel engine. Today, solid injection has replaced air injection, except for engines of very high horsepower. About 35 years ago, diesel engines were individual cylinder types operating at 200 rpm and weighing about 300 lb per hp. Today, moderately-sized diesels operate at about 1800 rpm and weigh only about 8 lb per hp.

Power unit sometimes used is a six-cylinder, two-cycle diesel engine with a compression ratio of 17 to 1 that burns 0.45 lb of fuel per bhp hour. With rpm varying from 1100 to 1800, the engine develops from 125 to 205 bhp for intermittent operation and from 110 to 180 bhp for continuous service.

This two-cycle engine requires only two strokes of the piston to complete a cycle, thus producing a power stroke for each revolution of the crankshaft. The two-cycle unit does not function as an air pump because both its intake and exhaust strokes occur during part of the compression and power strokes. It features a blower that is used to force air into the six cylinders, expelling exhaust gas, filling cylinders with new air.

Diesel engines may incorporate a pneumatic starting system. These simple and reliable units are relatively unaffected by temperature extremes, and usually require only a 8-10 cu ft tank at a pressure of about 150 psi.

Dual-Fuel Engines

Constructed basically the same as a diesel engine, the dual-fuel or spark-ignition gas engine has speed and horsepower ratings similar to the diesel. Power rating of the gas engine, however, varies considerably, depending on the type and heat content of the gaseous fuel. Operated as a diesel engine, the unit burns a wide range of crude and fuel oils. As a dual-fuel unit, the engine burns natural, manufactured, sewage, butane, or propane gas with a small percentage of diesel oil. (If gaseous fuel becomes unavailable, unit converts easily to burning diesel oil.) In spark-ignition gas operation, these dual-fuel units burn the same gases as those used in dual-fuel operation.

Spark-ignited gas engine, usually aspirated or turbocharged, is used when an adequate gas supply exists. It is a modification of the usual diesel and dual-fuel engine and offers the same low operating and maintenance costs and general over-all

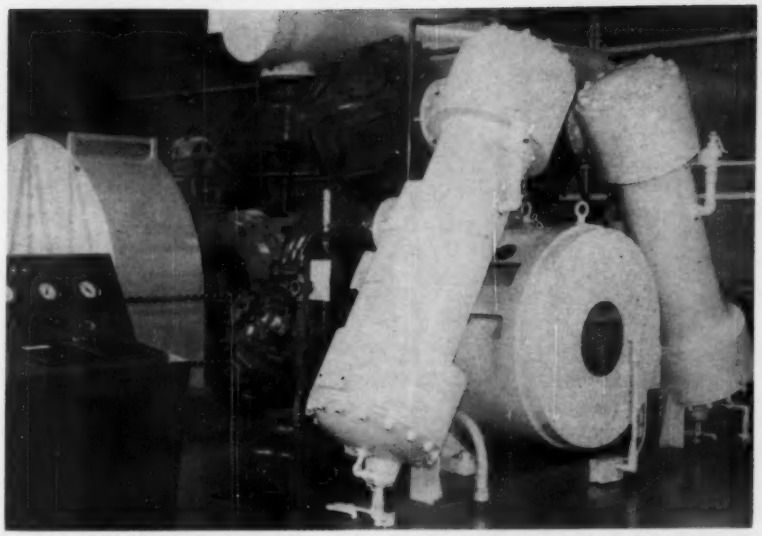


Fig. 2. This double-acting compressor is driven by flange-mounted electric motor

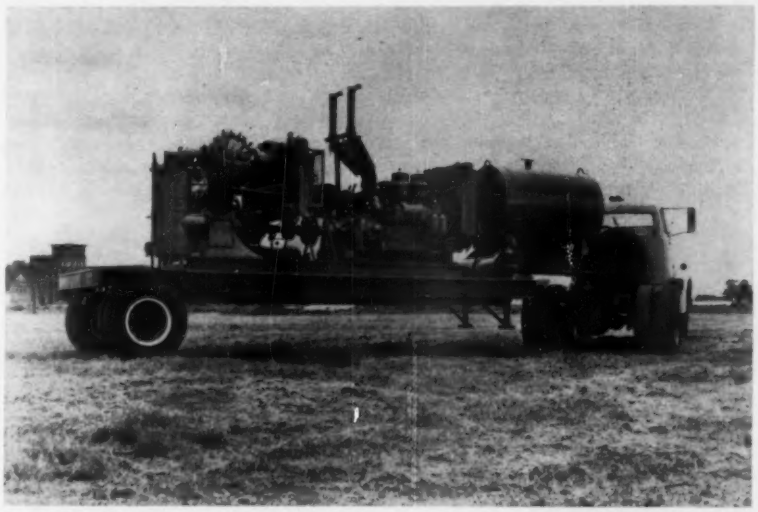


Fig. 3. High-pressure unit has diesel drive and all necessary cooling apparatus

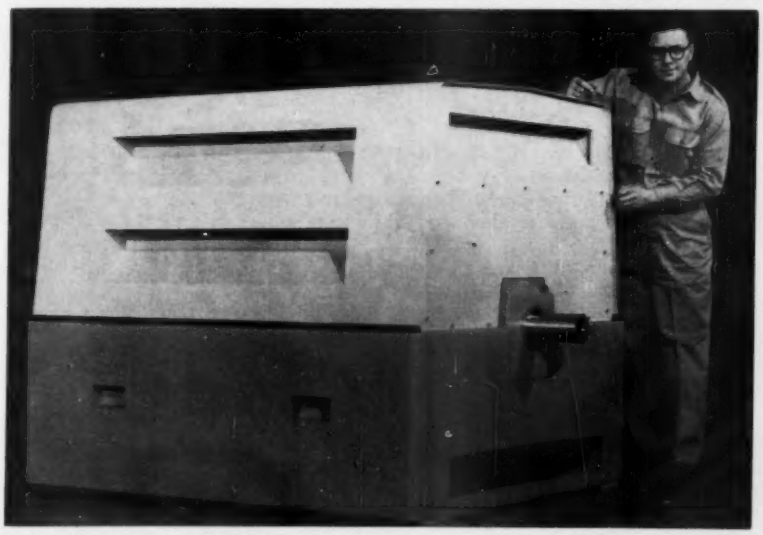


Fig. 4. Squirrel-cage electric motor is used as constant-speed compressor drive

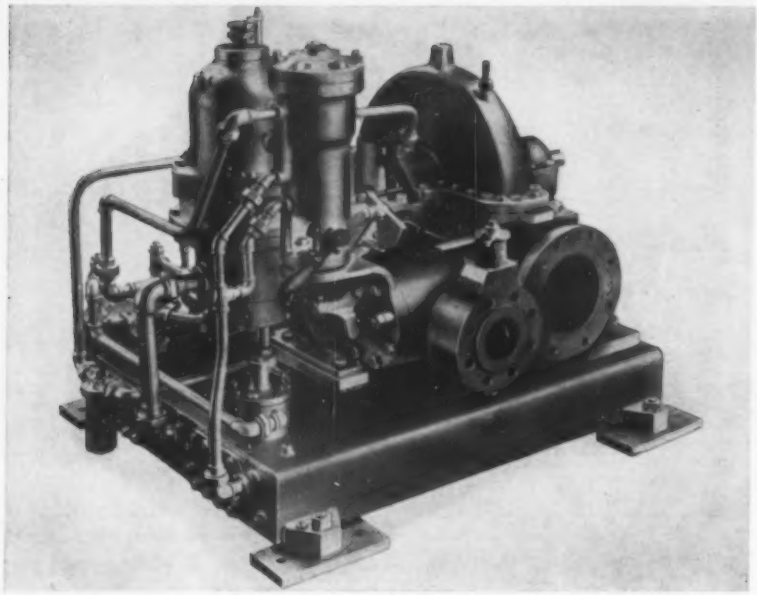


Fig. 5. Single-stage turbine is used for standby, intermittent or continuous use

dependability of the diesel and dual-fuel unit. The exhaust turbocharger is basically an exhaust gas-driven turbine and centrifugal blower with integral housing and with both turbine and blower rotors on the same shaft.

Gas Turbine Components

Gas turbine power plants of up to 5000 hp, for mechanical drive of compressors, blowers, fans and the like, are available with or without a regenerator and for use with either gaseous or liquid fuel. These gas turbines have five major components to develop rotary power from the expansion of hot gases:

1. An axial air compressor (air for combustion is compressed by as many as eleven stages).
2. A regenerator (which uses hot exhaust gases to heat the incoming air before combustion for high thermal efficiency).
3. A combustion system (steel combustion chambers are placed radially between the compressor and the gas turbine to extract thermal energy for turbine power).
4. The compressor turbine (usually a two-stage unit that converts part of the thermal energy into mechanical energy to drive the axial air compressor).
5. The power turbine (a single-stage unit that converts additional thermal energy into mechanical energy to drive the load, or main compressor).

If the exhaust gases, at about 900 F, are not used in the regenerator to heat incoming air, they may be used to heat feedwater or, in a processing operation, as combustion air for a boiler. The power shaft, mechanically independent of the compressor shaft, may be varied over a wide range, according to the load on the main compressor.

Gasoline-engine drives are highly favored for powering portable compressors which must operate at remote locations such as mines, quarries, and construction sites, where other types of power are either not available or practical.

The gasoline engine used is, of course, basically the same as that which drives a passenger car, truck, or bus. It is normally an integral part of the portable unit, which is then a self-sufficient entity. For a typical two-stage, air-cooled unit, the gasoline engine burns comparatively low-octane fuel, has four cylinders, and drives a compressor that produces 75-cfm, 100-psi air.

At maximum desired output air pressure, a governor slows down the engine; conversely, when receiver (tank supply) air drops to a predetermined level, the engine speeds up to normal operating speed. Positive shaft alignment is secured by bolting the compressor and engine crankcases together. Engine and compressor thus become a rigid assembly with a swivel support at the engine end. A thermostat in the engine water-cooling system regulates the flow for automatic warm-up control.

Large squirrel-cage electric motor shown in Fig. 4 is a constant-speed unit with three basic components: bearings, stator, and rotor. It features easy accessibility with cable leads through the base, removable side and end panels to inspect conduits, windings and bearings, and a take-apart housing that is separate from the stator.

Bearings and oil rings are split to provide for easy maintenance, and balanced oil rings aid in providing lubricant to the bearings.

Stator core is an assembly of annealed silicon sheet steel; steel spacers form core-ventilating ducts and steel plates at each end of the core support the stator teeth. Stator coils are insulated with mica wrappers, impregnated with resin, and varnished, resulting in an insulation with high dielectric quality.

Rotor is an all-metal unit. Its core is a punching that is pressed between steel end plates keyed to a spider which is, in turn, keyed to the shaft.

This type of motor develops from 250 hp at 600 rpm to about 3000 hp at 1800 rpm. It is suited to compressor, fan, blower, and other drive purposes.

When steam is readily available and power is required, either the steam turbine or engine provides a drive that is dependable, economical, and simple with a wide speed range and quick response, high starting torque, and excellent overload capacity. A plant that uses steam for heating or process work can first utilize the power in its steam to drive a compressor and then apply the exhaust from the engine to the heating or process work.

Figure 6 shows a single-stage turbine rated at from 5 to 4000 hp and 1000 to 12,500 rpm with initial steam to 1450 lb at 1000 F and exhaust to 300 lb. This turbine, an impulse-type unit, provides economical and reliable service for standby, intermittent, or continuous operation.

Modern Compressors

Steam-driven compressors have been used for over fifty years with a wide variety of steam engines, including both horizontal and vertical types. Typical of the modern steam drive is a horizontal, duplex design with either simple or compound steam cylinders. Most steam-driven compressors must meet definite conditions of steam supply, steam exhaust, and air needs. To meet these varying conditions, many types are available with a wide range of simple or compound steam cylinders and air ends. With this flexibility in choice, the expansion ratio per cylinder and cut-off point are kept within economical limits, loads can be conservative, and an adequate reserve of steam horsepower can be maintained. THE END

Application of Waterwalls To Low-Pressure Boilers

Efficiency and capacity can be materially increased by adding furnace extensions to existing boilers. Can be installed on most types of oil- and gas-fired boilers. Forced circulation, plus greater length of flame-travel, account for reduction in boiler fuel input

INCREASE IN EFFICIENCY, of commercial and industrial low-pressure boilers, has lagged far behind comparable developments in the high-pressure field.

This fact might well be due to the need for simple, low-cost steam-generating units, installed where a high degree of maintenance is not warranted. Or it might be due to the highly competitive market in this field.

Regardless of the causes, many low-pressure installations are operating today under very inefficient conditions. And many boilers are not performing at highest capacity, due to this lack of potential efficiency.

Most low-pressure steam-generating units employ standard firebox boilers, of three or four basic types. Due to their shortcomings in design, a great many of these are not capable of producing a reasonably high degree of efficiency when used as oil-fired units.

Because firebox boilers were originally designed to burn coal, their furnaces are of a square, or oblong, configuration. This type floor plan does not adapt itself to the long, narrow characteristics of most oil flames.

Another fault of some firebox boilers is the fact that the furnace volumes are critical, due to the low heat-releases required by non-absorbing surfaces. This is a factor of life expectancy, insofar as masonry and boiler steel are concerned.

Also, in most firebox designs, the highest heat-release occurs in the most vulnerable part of the boiler, namely the mudlegs. If maintenance is not good, and a strict blowdown schedule is not followed, several inches of sediment can collect in the narrow confines of these mudlegs.

Many boilers have failed because of sediment in mudlegs, plus the high heat-release of oil-firing. If no failures occur, it is still quite evident that no great degree of efficiency can be attained under most operating conditions.

To overcome the principal faults of most firebox boilers, it has been necessary to correct two weaknesses. First, greater flame-travel must be provided; next, some forced-circulation has to be added. And to be most acceptable to the owners, the corrective measures must be incorporated into a packaged unit which can be added to the existing boiler.

These deficiencies of the firebox boiler have led to the natural development of the low-pressure, plate-type Waterwall extension. This is a primary furnace wherein combustion originates. It is a cylindrical furnace, consisting of two cylindrical walls made of firebox-quality boiler plate steel, sealed at both ends with the same grade steel.

Why This Article

While this general type of water-cooled furnace extension has been on the market for some years, apparently its benefits are not too well known. We felt our readers would like to know more about it.

This unit is designed around the principle of forced recirculation, which is accomplished by the incorporation of an impeller-type pump. This pump moves water through the Waterwall extension; the water is drawn from the boiler, and returns to it. Short pipe connections, made on the job, take care of this attachment.

Since the quantity of water circulated through the Waterwall is substantially greater than the amount being evaporated into steam, there is no possibility of film-boiling, or flashing, which are major causes of boiler plate failure. This feature, which was originally intended as a protective measure for the Waterwall, has been found to protect the boiler also.

Installation methods of these Waterwall units are relatively simple. The burner-unit is removed from the existing boiler; the new Waterwall unit is attached to the front of the boiler; then, connections are made for the piping from boiler, to pump, to Waterwall, and a return to the boiler.

Piping connections from, and to, the boiler are made at locations based on experience and a knowledge of the

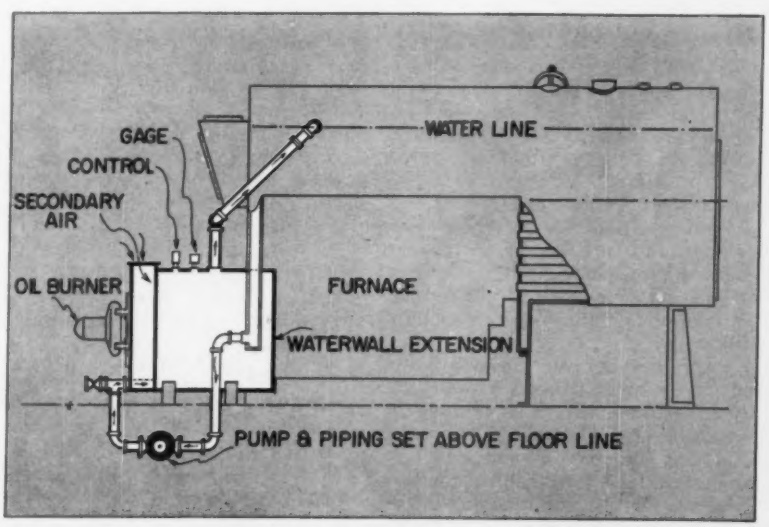


Fig. 1. Waterwall furnace extension installed on a portable firebox boiler. Short furnace on this type unit prevents high firing efficiency, but extension overcomes this fault. Pump furnishes forced-circulation of boiler water through extension

Fig. 2. This photograph shows workman installing the Waterwall furnace extension on the existing boiler. Pictured in the foreground are the pump and the piping

design of the boiler being modified. Basic principle is to select points on the boiler which will provide adequate supply for pump suction, and a return which will be about midway in the normal boiler waterline. (This prevents wet steam from entering the boiler outlet main.)

These Waterwall extensions also have been successfully adapted to water-tube boilers (of the inclined-tube type), bent-tube type, and long-drum and cross-drum types. Further, they are in use with both HRT's and Scotch Marine-type boilers.

An additional benefit of this boiler extension is the substantial gain in total capacity. Since combustion originates in this section, which is highly heat-absorbent, the initial flame temperature is lowered as much as 1000 F. This permits the boiler to be fired with absolute safety far beyond its automatically-fired rating.

As an example, in converting an existing 200-hp boiler to Waterwall, a gain of up to 36 hp can be made. To this can be added the additional capacity of the boiler when fired at 150 per cent of rated load. The total resultant increase is 136 hp, or 68 per cent. This feature might well be the determining factor when considering new capital investment in boiler equipment.

Ratings of Waterwalls

Ratings of these Waterwalls are based on two sq ft of heating surface per bhp. (This is obviously two and one-half times the normal rating of the boilers being discussed.)

An independent laboratory test of a Waterwall installation showed an actual rating of 1.32 sq ft of heating surface per bhp. This was based on inlet water at 185.5 F; outlet water at 211.5 F, 126 gpm; 62.5 sq ft of heating surface; and a firing-rate of 40.5 gph of oil.

In the above test, a flue-gas analysis gave CO_2 readings from 7 to 11 per cent. This is, of course, much better than averages obtained through normal installations of the boiler without a Waterwall extension.

Very little additional building space is required for the installation of these units. In fact, sufficient floor space is available in practically all boiler rooms where an installation would be made.

For more information, write the Editor, or jot Waterwall on the enclosed Inquiry Card. THE END

BCI Surveys the Nation's Big Coal-Users

A RECENT SURVEY conducted by district engineers, managers, and the Market Research Division of Bituminous Coal Institute clarified some basic financial issues pertaining to the use of coal as a fuel. Annually, each of the 225 participating firms uses more than 3000 tons of coal.

First question asked: Would you evaluate an investment in power plant equipment on the same economic basis as an investment in production facilities such as machines and tools?

Sixty-eight per cent indicated they put the power plant on a par with other facilities insofar as capital investment is concerned; 32 per cent told that they have less dependence on heat and power in their production processes or are not sufficiently informed about how much of the production dollar goes into such services.

Question 2. In replacing or modernzing power plant facilities, would you select higher initial investment plus lower operating costs rather than lower the initial investment?

Yes, said 93 per cent. Experience, however, proves that power plant facilities are not renewed or modernized to achieve lower costs at the same rate as other production facilities are turned over.

In connection with question 2, question 3 asked: In choosing the course of higher investment, how soon would you expect payback on the additional investment? Table gives results from 204 reporting firms:

PLANTS		PAYBACK PERIOD
No.	%	(Years)
19	9.3	1 to 3
47	23.0	3 to 5
73	35.8	5 to 7
21	10.3	7 to 9
33	16.2	9 to 11
11	5.4	over 11
204	100.0	

Although the trend is upward in leasing all or part of power plant equipment, 71 per cent said they would not lease theirs. Due to additional cost associated with coal-burning equipment, leasing is important to the coal industry.

Question 5 asked: Are you now using coal as a result of a current evaluation or a past evaluation of fuel economics? Past evaluation, answered 58 per cent respondents. Lack of continuing evaluation of fuel economics, BCI says, indirectly shows why many power plants are not physically up-to-date. These plants often could be more economically operated by using coal.

Final question asked if power plant investment is based strictly on economics alone. Eighty-two per cent answered that straight economics govern (fuel, equipment costs, labor, etc).

BCI concluded that the economics of coal use should be well emphasized.

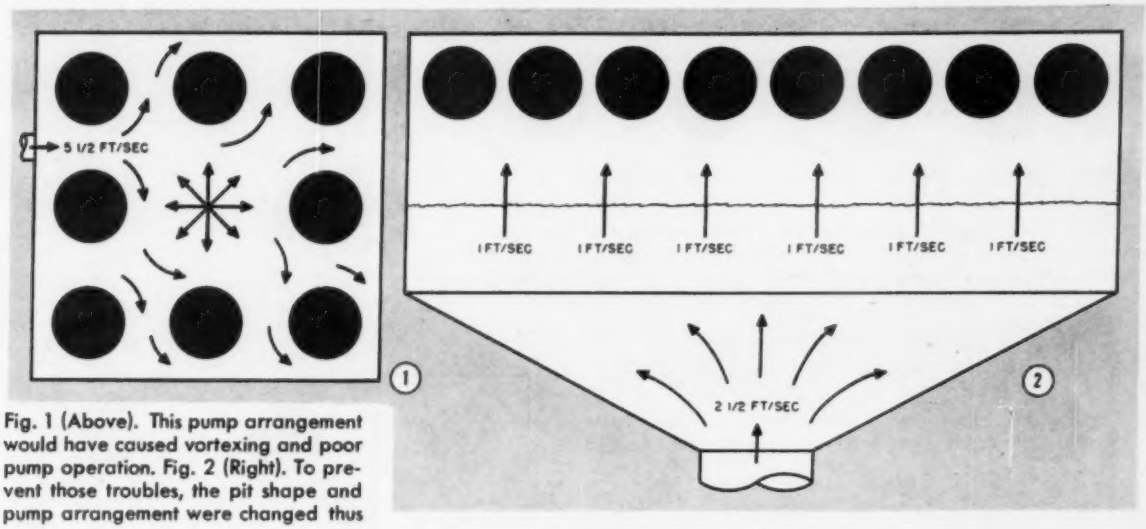


Fig. 1 (Above). This pump arrangement would have caused vortexing and poor pump operation. Fig. 2 (Right). To prevent those troubles, the pit shape and pump arrangement were changed thus

Stop Pump Problems Before They Begin— With Proper Pump Pit Design

In installing pumps, power engineers must provide properly-designed pump suction pits, to get most economical pumping. In doing this, three problems arise: high suction-pit velocity; flow direction changes; inadequate submergence. Here are ways of solving them

By WILSON L. DORNAUS*

PERHAPS THE MOST important aspect of pump design, insofar as it affects power engineers concerned with the economic operation of pumping machinery, is in regard to the suction pit and intake arrangement. Unfortunately the pump designer does not often have the final say regarding the arrangement of the pumps and competitively may be forced to accept inferior sump designs in which to install his pumps to avoid losing valuable orders.

There is usually a happy balance between optimum hydraulic conditions and the best economic practice which will result in a satisfactory job for both supplier and user.

Since the majority of pumping problems occur due to improper consideration of suction conditions, it would seem that following the best procedure in the design of pump pits would result in the most carefree pumping applications. Engineers interested in reducing maintenance costs and operational problems will do well to study a few basic rules and apply them to future pump pit designs.

Three basic problems arise in the design of a pump pit which affect its original size and cost, and the proper handling of these problems will minimize or eliminate cavitation and erosion of pump parts as well as the surrounding structure and appurtenances. High suction-pit velocity (over one foot per second), change in direction of inlet flow as it enters the pump area, and inadequate submergence over the suction bell are the three main causes of poor pump operation.

For example, a request was made to supply eight large vertical pumps to be uniformly spaced around the periphery of a rectangular pump pit, Fig. 1. The capacity of the pumps was such that with only one inlet pipe provided on one side of the structure, the pipe velocity was five to six feet per second, and although the velocity in the pit dropped off to less than one foot per second because of the size of the pit, the water had to travel in every conceivable direction to reach each pump, and therefore was moving in a circular path at the time it entered the influence of the pump suction bell.

Even with better than minimum submergence this would have resulted in a very poor pumping condition since the change in direction of the water path would have induced vortexing, which leads to rough pump operation and eventually the deterioration of bearings and shafts.

Problem was resolved by arranging all of the pumps along one wall, changing the shape of the pit to a long, rectangular structure with the inlet water entering each pump suction simultaneously, Fig. 2. Usually this can be accomplished with approximately the same over-all building size in area as was originally contemplated. In many cases the structure can be even smaller than the original design, thus saving on the initial investment as well as eliminating future maintenance problems.

Another equally adverse arrangement consists of several pumps in a row in a long, narrow pump pit with the inlet water coming from one end, thus having to travel past each pump in turn, as in Fig. 3. This means that the channel velocity at the first pump must be equal to the combined flow of the total number of pumps divided by the rather narrow channel area. The channel velocity gets smaller as it passes each pump, but the disturbance in the stream flow by each pump has an adverse effect on each of the following pumps.

If such a structure is contemplated

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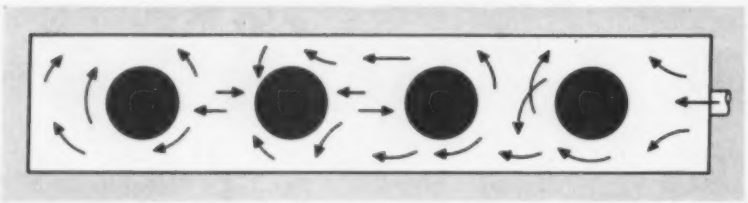


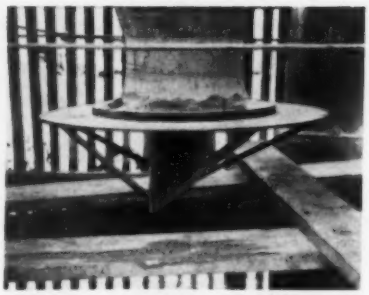


Fig. 3 (Above). In this long, narrow pit, disturbance by each pump has adverse effect on others. Fig. 4 (Right). Suction splitters at pump suction, like the one shown, assist in preventing vortexing that might otherwise occur without the application

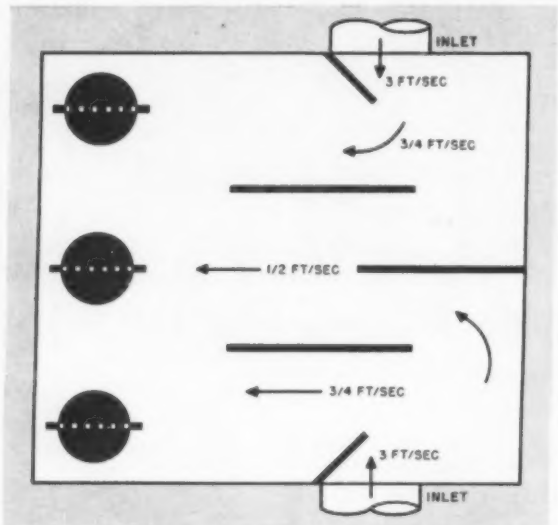


Fig. 5. If velocity into pit is excessive, baffles like this help to slow velocity, form as quiet a pool as possible for suction

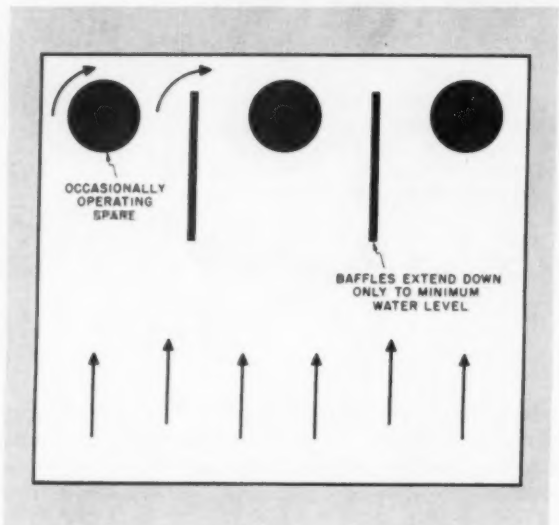


Fig. 6. If one pump operates only occasionally, baffles should not join pit walls, so large eddies will not form

in the initial design, the inlet water should be rerouted to come in from one side for the full length of the structure where the pumps are installed. If an existing structure has such an arrangement and the pump maintenance is rather high, the pumps may have to be rearranged in the existing space and some control baffling introduced into the sump. Suction splitters are sometimes applied to the suction bell of a pump to assist in preventing vortexing from interfering with proper pump operation, and these may take the place of other baffling or may supplement such baffling if the condition is severe. This is shown in Fig 4.

Small openings into such a pit where the velocity is excessive should be avoided, or, if existing, should be baffled to break down the velocity to form as quiet a pool as possible, like those in Fig. 5.

Where a few pumps are to be installed in one corner of a rather large pit, it may be tempting to wall-off the pit to provide a chamber for the pumps. It may even be thought to be advantageous to separate each pump with a baffle wall. In a very large pit, where the velocity is almost negligible, these walls are not necessary for hydraulic purposes, although they may be needed for structural reasons.

Wherever they are installed when there is a possibility of fewer than the total number of pumps operating at any given time, the walls should not carry through and join the structure at the rear of the pump chamber, Fig. 6. An opening from one to two feet in width and a height equal to the minimum water level should be left. This will prevent the formation of large eddies at the beginning of the baffle walls which will continue to vortex into the pump suction.

Proper Submergence Necessary

There is usually a temptation when constructing a pump pit to keep it as shallow as possible to avoid unnecessary excavation and concrete work. Quite often this is false economy, for the lack of proper submergence will cause pump troubles far in excess of the small amount saved.

Submergence requirements for pumps vary with the size of the pump and the speed of rotation. The combination of the velocities at the impeller suction eye at the first stage determines the amount of submergence required over the center line of the impeller. Good practice dictates that for eye velocities of about 20 ft per sec and peripheral velocities of about 65 ft per sec, the required submergence should be from two to five feet, depending upon the size of the pump, Fig. 7.

As velocities increase, the submergence should also be increased. Additionally, these values should be increased for higher water temperatures and elevations above sea level. Sometimes to avoid excessive building costs, a rather shallow pit is deepened in one corner or at one end to form a sump for the pump. When this is done, a rather sudden drop-off should be avoided, and the flat approach to the pump itself should be from four to eight times the diameter of the suction inlet bell, as demonstrated in Fig. 8. This diameter will vary between pump manufacturers because of individual requirements.

However, since velocity at this point is a loss in the pump directly attributable to the over-all efficiency,

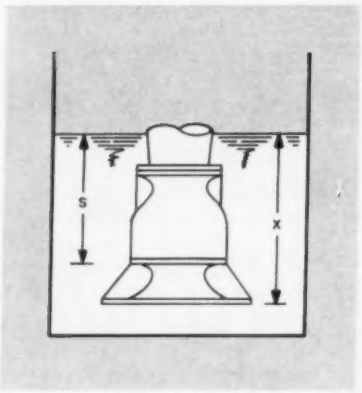


Fig. 7. S is impeller submergence; add length to suction bell for submergence X

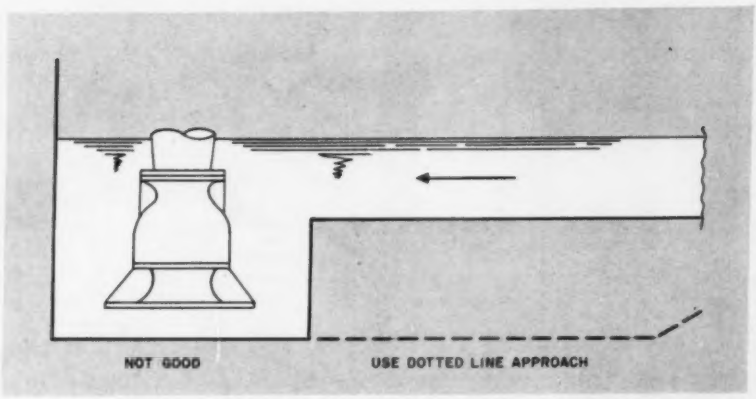


Fig. 8. Sudden drop-off in shallow pit (designed to avoid deep excavation and give lower cost) is not good; instead use approach as shown by the dotted line

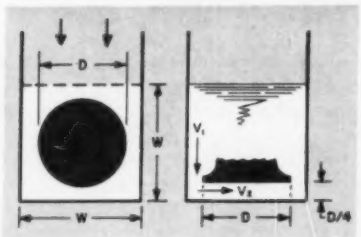


Fig. 9. Good practice limits suction velocities to ranges between 1½ ft per second and 3 to 4 ft per sec, depending on pump size and head; see text

Entrance velocity V, at suction bell, is due to area of bell ($\pi D^2 \div 4$), and equals V_2 below bell when bottom distance is D/4 ($\pi D \div D/4$). Entrance loss of one velocity head equals $V^2 \div 2g$, equals $V^2 \div 64.4$ (feet). See the complete text discussion

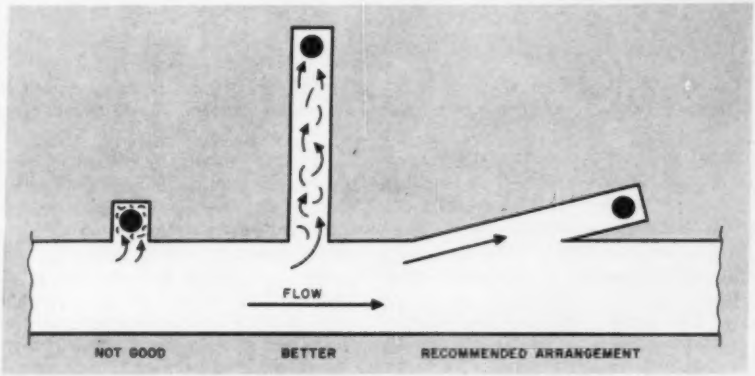


Fig. 10. Do not position pump pit at sharp right angles to flow if velocity is two feet per second or more. Better arrangements of longer inlets are shown

it is good practice to limit the suction bell entrance velocities to about one and one-half feet per second for pumps up to 15 ft head, to two feet per second for pumps from 15 to 50 ft head, and three to four feet per second for higher head pumps. This philosophy is evident from Fig. 9. These figures will give rough suction bell sizes for desired capacities, and minimum pit dimensions may then be roughed out.

Having determined the width of the pit to be from one and one-quarter to one and one-half times the suction bell diameter (the wider pit being necessary for the lower-head pumps), ascertaining the minimum water level due to pump requirements as given by the pump manufacturer will give the net cross-section area of the inlet water channel, which in turn gives the channel velocity. This velocity should be one foot per second or less. A slightly higher velocity through rotating screens or fixed gratings is permissible although these obstructions should be kept from two to four bell diameters away from the pump center line.

Pump pits located adjacent to streams with velocities of two feet per second or more should not be positioned at right angles to the stream flow. See Fig. 10. The water path entering such a pit must take a circular path to get into the pump pit, and it continues this circular motion to the detriment of the pump, since vortexes will occur. Depending on the velocity of the main stream flow, the pit should be located away from the stream a great enough distance so that the flow in the channel becomes straight and uniform, with a velocity of one foot per second or less.

Install at Correct Angle

Since this may require extensive excavation and concrete work, it may be desirable to install such a pump pit at an angle to the main stream flow so that a very slight change in direction of flow is noted. If this is not properly accomplished, the inlet velocity will undoubtedly be the same as the main stream velocity, which could give additional problems if correct baffling is not provided.

Where existing pits are being used where the change in direction of flow makes rather violent eddying and turbulence, the use of the aforementioned suction splitter plates will be helpful in reducing pump problems, and it may be necessary in more severe cases to float large sections of 2 by 12 boards or similar pieces to form rafts or other surface structures which will keep vortexes from forming close to the pump. In new construction, these adverse conditions should be avoided by proper original design.

If the situation is such that it is impossible to form a relatively quiet pool for the pump suction, it may be necessary to utilize suction elbow units, which are designed to admit water at velocities up to 10 ft per second, directly through a 90-deg elbow into the suction eye. Such an arrangement usually makes the pump more cumbersome to install and therefore is not so easy to maintain. One of these installations is shown in Fig. 11.

A pump installed in a stream with high velocity is also subject to the uneven pressure of the stream against one-half of the pump and column. This may result in excessive deflection of the shaft which will cause

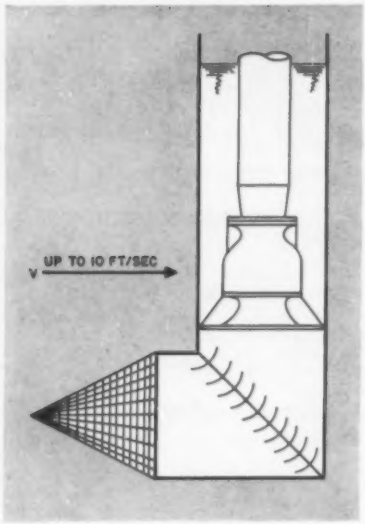


Fig. 11. If conditions prevent forming quiet pool, 90-degree elbow helps

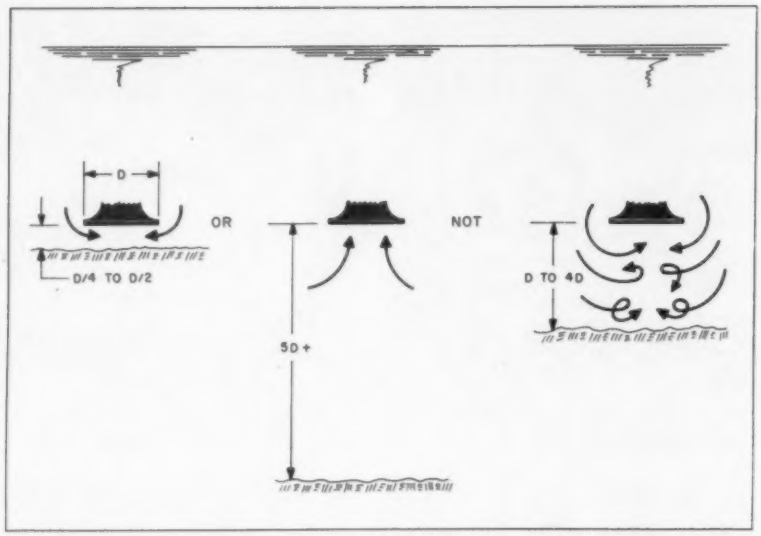


Fig. 12. In streams or lakes where bottom is uneven, position pumps properly above the bottom. The left and center positions are better than the right one

rapid wear on the shaft and the bearings. A pump installed in such a situation should be protected by piling or baffling, in an inverted U- or V-shaped, upstream from the pump in order to form a relatively quiet pool.

Care should be taken in installing pumps in streams or lakes with uneven bottoms to position the pump suction bell properly above the bottom of the pit. While it is always preferable to install a pump in a pit with a solid bottom such as concrete, circumstances may dictate that the natural land contour must be used.

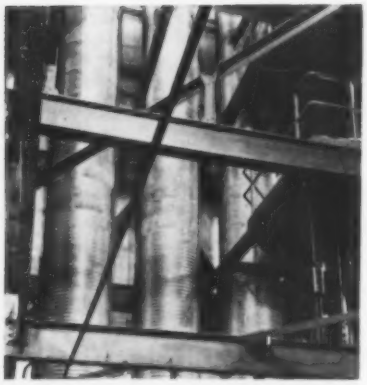
In such cases the bottom distances may have to be slightly greater than the normal minimum requirements to prevent build-up of dirt underneath the suction bell. If the bell is not to be located at approximately the minimum distance considered good practice, which will vary between one-fourth and one-half of the suction bell diameter from the bottom of the pit, then the pump should be raised at least ten to twenty times this distance to prevent "compressed vortexing," Fig. 12.

Compressed Vortexing

This is a turbulence generated by the proximity of the suction bell to the bottom surface in conjunction with specific inlet velocities. This allows the inlet water to rotate in a vertical direction so that only part of the shaped stream enters the suction bell, the rest of it rotating to the bottom of the pit and going through many such cycles before entering the pump suction. Unbalance and vibration in the pump will occur, leading to worn parts.

In summing up, the quality of the suction environment of a pump should not be sacrificed if excessive maintenance costs are to be avoided. Paramount in this direction is the establishment of adequate submergence, channel velocities one foot per second or below, and approach flow straight and uniform into the pump suction bell area. Stop the problems before they begin — with proper pump-pit design. THE END

New Type of Air-Ducts Reclaim Heated Air



Toledo's Bayshore Station uses corrugated metal pipe for forced-air ducts. Installation cost less, went in faster

RECLAIMING heated air from the area above the boiler for use in the combustion air stream is one way to improve the efficiency of a power plant. That was the opinion of engineers of the Toledo Edison Co in Ohio, when they drew up plans for their Bay Shore Generating Station. Specified to carry this warmed air to the forced-draft fans at the base of the boiler was a considerable quantity of Armco corrugated metal pipe — a product usually installed as culverts and sewers.

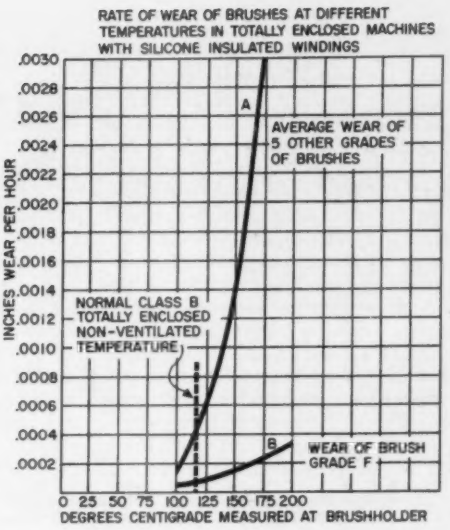
In using full-round galvanized corrugated metal pipe in place of the more conventional air-ducts, Toledo Edison Co figured on these advantages: corrugated design permitted use of lighter gages of metal; inherent columnar strength reduced required external bracing; and the complete project cost less, while permitting faster installation.

Eight forced-air ducts were required, each of 48-in. diameter. Total quantity of corrugated metal pipe was 842 ft. All pipe was supplied in 14 gage, and in lengths of 22, 20 and 11½ ft. A special requirement was that the circumferential seams be close riveted. Coupling bands, joining the lengths of pipe, were one piece and in 10 and 5 corrugations wide.

In another phase of construction of this plant, many Steelox panels were used as a partition wall. Supplied with the zinc-coated protection of Zincgrip steel, these panels were painted after installation.

The Facts on Brush Wear And Silicone Insulation

Advantage that silicone varnish offers to d-c motors is great, and stems from the fact that silicone varnish remains pliable and free from cracks for a much longer time than do older types. With know-how it can be used in enclosed motors. Graph at right shows comparable wearing rates



By C. B. HATHAWAY *

MUCH has been said about the rapid wear of brushes in the presence of silicone vapors at temperatures as high as 180 C, which is the limit specified by the AIEE for class-H insulation. It is not generally recognized that the wear of brushes is not seriously affected if the operating temperatures are within the limits of class-B insulation. Furthermore, there are now brushes available that do not have excessive wear when operating in silicone-insulated machines up to a temperature of 150 C.

When silicone varnish was first applied to ventilated d-c motors, no ill effects were noted. But when it was tried in enclosed machines operated at a temperature of 180 C, trouble arose. Presence of silicone vapor caused the brushes to throw down a black deposit on the face of the commutator. This deposit was uneven and acted like a grinding wheel against the face of the brushes. Thus the brushes were ground down to a short length in a few hours.

This condition has never been found in an open motor or in one where fresh air flows through continuously. It has been discovered in some cases that brush wear can be affected when an open motor operates at 180 C temperature in a small room or compartment, when the total air will slowly become contaminated with silicone vapors.

There are certain requirements that must be met to keep the brush wear from becoming excessive in an enclosed motor with silicone insulation:

1. The silicone varnish must be thoroughly baked. Long baking at 200 C does a thorough job.

2. Avoid the use of silastic tapes and cables. They have a strong tendency to give off vapors which accelerate brush wear.

3. Select carbon brushes properly. A good brush will give long life in an enclosed motor if the temperature does not exceed limits set up for class-B insulation (130 C). A specially selected brush will be needed where the temperature is between 130 and 150 C.

4. Do not operate the motor above a temperature of 150 C.

Elaborate tests plus field experience justify these statements. Tests were made about five years ago using many grades of brushes. The rate of wear of brushes was plotted against the operating temperature as measured by a thermocouple on the brush holder. The tests were made on an enclosed d-c motor. The brushes rode on a commutator rather than on slip rings. One particular grade of brush stood out among all others. It had a rate of wear about 1½ times normal at 150 C, two times normal at 175 C, and about 3½ times normal at 200 C. Normal rate of brush wear is usually considered to be about one-tenth of a mil per hour.

The graph shows the comparable wearing rates. Curve A indicates the average rate of wear of five other grades of brushes used in Westinghouse motors. Curve B indicates the one brush that had outstanding resistance to wear.

The first field experience was a case when necessity was the mother of invention. An enclosed motor designed for a continuous rating of 50 hp was being loaded to 77 hp. It had class-B insulation and would roast out in a few weeks. There were about 25 of these in operation.

An external fan and a shroud were added to give them the fan-cooled feature, but this was not enough. The windings continued to roast out.

An investigation revealed a total temperature of 150 C. This happened to match the temperature observed with the grade-F brush on the tests.

With some qualms, it was decided to wind one of the motors with silicone insulation and try the grade-F brush and see if this was an answer.

This motor had not developed any real trouble at the end of three months, and the customer was reluctant to remove it from service. After seven months' operation, the motor was removed and dismantled for an examination. The loading during this time had been kept at 77 hp with a temperature of 150 C.

The silicone-insulated windings were still plastic. No brittleness could be found. The wear of the brushes ranged from 1/32 to 1/16-inch. This was actually less than anticipated. As a result of this test, the motors on the remaining machines were rewound with silicone insulation, and operated satisfactorily. THE END

Why This Article

It is generally agreed that brush wear is not particularly abnormal in silicone-insulated d-c motors with fresh air passing through the machine continuously, even if the windings reach a temperature of 180 C. The area of doubt and misunderstanding applies to enclosed motors. This article clears up that misunderstanding.

*Manager, D-C Motor Engineering Dept, Westinghouse Electric Corp

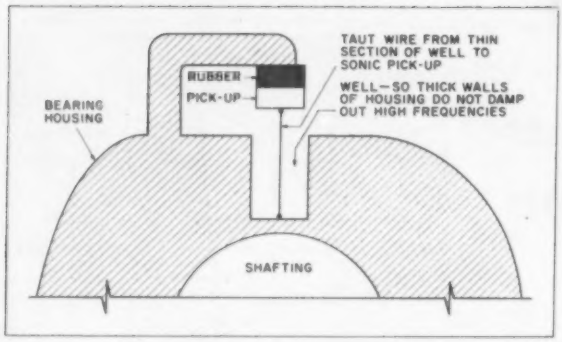

TAUT WIRE FROM THIN SECTION OF WELL TO SONIC PICK-UP
RUBBER
PICK-UP
WELL—SO THICK WALLS OF HOUSING DO NOT DAMP OUT HIGH FREQUENCIES
BEARING HOUSING
SHAFTING

Fig. 1. Method of mounting sonic pickups. Where thick walls might damp out high frequencies, wells in housing are used

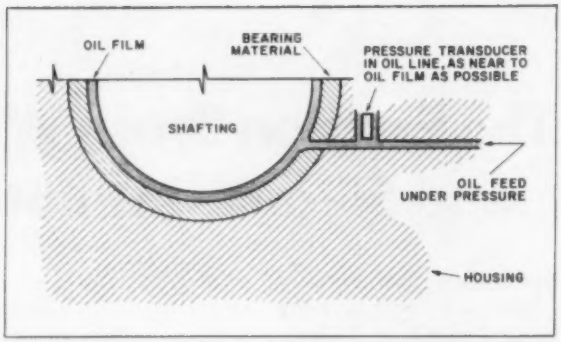


Fig. 2. Mounting of pressure pickup is shown here. Pressure transducer is mounted in line as near oil film as possible

Would a Sonic Monitoring System Work On Today's Turbine Generators?

Here is a thought-provoking article that suggests an entirely new concept in turbine supervisory systems. What do our readers think?

By PAUL N. GARAY*

ADVENT OF increasingly severe operating conditions for turbines and other rotating machinery has added greatly to the complexity and importance of detecting malfunctions and anticipating failure.

For a great many years, the usual guide to operating conditions has been oil temperature. It is obvious that oil temperature measurements, as they are usually taken, represent the average bulk temperature of the oil in the oil piping system. Such measurements are far too slow and of a much too general nature to give adequate indication of incipient failure of individual bearings. U. S. Navy has had some success with bearing temperature indicators that measure temperature of the oil film in the journal.

Since malfunction of a bearing may cause temperature of the metal to rise to the point of failure in a few seconds, measurement of the metal temperature is the key to detection of impending failure, and much effort has been expended with this goal in mind. Vibration detectors, foundation settlement indicators, oil pressure and temperature indicators, and position indicators are all used to good effect.

It is interesting to note that a large company has developed a foundation subsidence indicator, solely because one of their large machines showed a change of 200 rpm in critical speed at start-up. Subsequent investigation revealed that a fault in the soil beneath the foundation had caused some subsidence of one leg of the foundation.

A good possibility that any change in physical conditions of rotating machines may be easily detected exists in use of sonic measurements. All mechanics are familiar with the stethoscope, with which it is possible to amplify and isolate the noise of any component of an operating machine.

Operation of System

Such a system of sonic monitoring as presently visualized by the author would operate thus: Sonic detectors are mounted at several locations on the turbine (or other machine). These detectors should be strategically placed at the bearings, at the packings, on gears, and in generalized locations. Effect of vibration on the sonic detectors may be cancelled by proper mounting of the pickups, or by selecting a detector that is insensitive to the relatively large movements caused by vibration. (A vibration indicator might be used as a source for a comparison signal.) Signal from each pickup is then presented on an oscilloscope, and a permanent record of each noise at each location is made by photographing the scope trace with a Polaroid camera.

Simultaneous with the noise signal, a standard reference signal is shown on the screen, so that the relative magnitude of the sound is always easily evaluated by comparison with the reference signal.

Amplification system of the oscilloscope will make it possible to study in detail any suspicious peaks in the oscilloscope trace. Various sounds emanating from the machine, such as gear noises, bearing noises, steam flows, and the like are all in well-defined frequency ranges. By selecting a desired frequency and amplifying it, sounds of gears, bearings, or of steam escaping from a gland would be very evident, and thus would indicate the true operating condition.

When the turbine is first placed in operation, a pictorial record should be made of the oscilloscope trace of each such noise. Thereafter, it would be routine to compare the original trace with the graph, which can be made once a month, or as desired. Gear wear, bearing noises, and steam leakage will all show definite oscilloscope patterns. As a matter of fact, the windage noise which might be picked up by suitably located detectors inside the turbine casing may even indicate missing blades or the accumulation of blade deposits.

This same system can be further connected with an audio amplifier; the mechanical supervisor of the plant may then listen to the turbine noises at routine intervals and determine if further attention is indicated.

* Associated with Kaiser Engineers, Div of Henry J. Kaiser Co

An automatic alarm device may be activated by unusual noises originating inside the turbine.

This system should be relatively inexpensive, simple, direct, and sensitive. Best of all, it provides a source of visual performance comparison between a new turbine and the same turbine after a period of use.

Another method of turbine supervision that merits consideration consists of a pressure transducer which is small enough to be placed in the oil line immediately adjacent to a bearing. The transducer output is fed into an oscilloscope, as before, and pressure variations in the oil film at the bearing face are visually presented. Any shaft misalignment, eccentricity, or shaft whip will show up in the scope trace. Any change in bearing oil pressure *at the bearing face* may be compared with oil supply pressure, and the variations will be indicative of temperature and load effects.

Use of Plastic Coating

New material that may prove extremely valuable is a thin coating of special double-refracting plastic that, cemented to an actual part, will follow every surface strain. When polarized light is reflected by the coated part and viewed through a polarizing instrument, color patterns are produced that can be interpreted quantitatively in terms of surface principal strains.

Almost any part or structure made from almost any material can be coated with this special plastic. Color of the reflected light is observed with a reflection polariscope and compared to an accompanying color chart with reasonable accuracy. It may be measured quite accurately to plus-or-minus 10-microinch-per-inch strain. Extreme accuracy of plus-or-minus 0.2-microinch-per-inch can be attained with a photo cell.

Temperature changes may, in time, affect refraction properties of the coating. At temperatures over 100 F, known temperature corrections should be applied. Part under inspection must, of course, be visible. For qualitative results with accuracy of plus-or-minus 150-microinch-per-inch, the indicating coating may be covered with a thin sheet of polaroid plastic, which makes color patterns visible without additional equipment.

There are many possibilities for which use of this refracting material can be made in investigating turbine installation and operating conditions. One such possibility is to indicate the change in loading on foundation structures, flanges, and other visible parts which may be observed when bolts are being pulled up. Excessive or uneven loadings will be readily detected. Same type of indication may be used when bolting up cold piping sections, or when attaching pipe flanges to machinery. Bolt stress can be measured if the bolt is visible between two flanges. Flange compression may be measured by an indicating film on the exposed edge of the flange.

When applied to mating shafts, this material will immediately indicate misalignment. As coupling bolts are being drawn up, the color change will indicate an eccentric loading on the shafts. After bolts are tight, rotation of the shaft by hand will produce varying color patterns around the shaft circumference if there is misalignment. Effect of attaching pipe flanges or pulling down foundation bolts will also be optically visible on the shaft of the machine.

In the event cyclic loading is too fast for the eye to discern (above 8 cps) a stroboscopic light may be used to slow down variation so that it readily may be observed.

Brief discussion of a new method of measurement of torque in an operating drive shaft is in order. A photo stress torquemeter uses a dual polariscope transducer to measure the intensity of polarized light from a plastic-coated rotating shaft. This reflected light, reaching the photo cell from the bonded section, changes color with torque. Light from an unbonded (unstrained) section of the shaft is available for reference.

Final output of the instrument is an accurate, useful signal in the form of mechanical movement of a lead screw. Equipment combining the torquemeter and a tachometer gives continuous reading of power. Sensitivity is 0.05 per cent of full scale, accuracy is 0.05 per cent of full scale, and maximum rpm is unlimited. However, in measuring cyclic stresses, the compensated polarizing instruments are limited to about 20 cps. There is available a single-channel system, however, which has a frequency response up to 30,000 cps.

This article is presented as a preliminary exploration of an interesting solution to the problem of analyzing machinery defects before failures occur. The author and editors of POWER ENGINEERING will be very interested in hearing from interested readers with ideas on this very fascinating subject. THE END

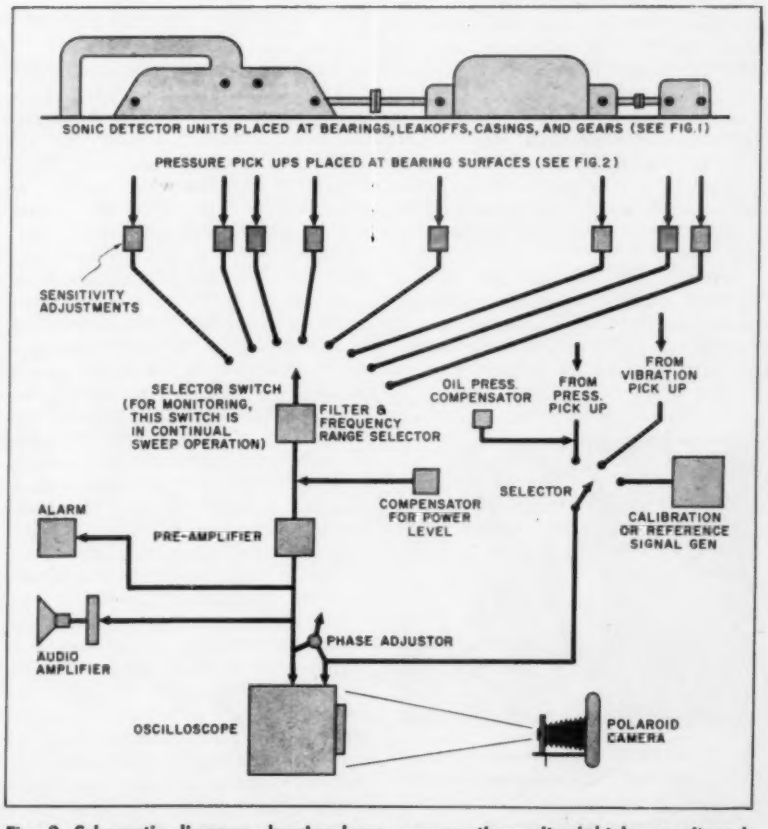

SONIC DETECTOR UNITS PLACED AT BEARINGS, LEAKOFFS, CASINGS, AND GEARS (SEE FIG. 1)
PRESSURE PICK UPS PLACED AT BEARING SURFACES (SEE FIG. 2)
SENSITIVITY ADJUSTMENTS
SELECTOR SWITCH (FOR MONITORING, THIS SWITCH IS IN CONTINUAL SWEEP OPERATION)
FILTER & FREQUENCY RANGE SELECTOR
OIL PRESS. COMPENSATOR
FROM PRESS. PICK UP
FROM VIBRATION PICK UP
SELECTOR
COMPENSATOR FOR POWER LEVEL
CALIBRATION OR REFERENCE SIGNAL GEN
ALARM
PRE-AMPLIFIER
AUDIO AMPLIFIER
PHASE ADJUSTOR
OSCILLOSCOPE
POLAROID CAMERA

Fig. 3. Schematic diagram showing how a generating unit might be monitored, using an oscilloscope and camera to provide permanent record of unit condition

ASME Holds 1959 Annual Meeting at Atlantic City

BREAKING its usual pattern of meetings in New York City, the American Society of Mechanical Engineers held its 1959 annual meeting at the Chalfonte-Haddon Hall in Atlantic City, New Jersey, November 30 to December 4. Over 3000 members of the Society attended and they, together with the three POWER ENGINEERING editors who covered the meeting, agreed it was one of the most successful held by the society.

Walker L. Cisler, President of Detroit Edison Co, took office as the new ASME president, succeeding Glenn B. Warren of General Electric Co, the retiring president.

Gwilyn A. Price, Chairman of the Board, Westinghouse Electric Corp, was awarded the John Fritz Medal for his leadership in the development of atomic power. The Towne Lecture was delivered by Lt. Gen. James M. Gavin, now executive vice-president of Arthur D. Little, Inc, whose address was one of the outstanding features of the meeting. Another outstanding feature was the address given at the annual banquet by Marcus Long, Professor of Philosophy at the University of Toronto. Dr. Long criticized the professional modesty of the engineer, stated that his genius and industry have helped greatly to control nature. This modesty, he advised, should give way to advertising of the engineer and his profession.

Honors and medals for distinguished service were conferred on many members of the society, and a number of junior awards were made for outstanding work in various fields and for papers on technical subjects.

Fig. 2. At 1959 Annual ASME Meeting, l to r, incoming 1960 President, Walker L. Cisler, is greeted by O. B. Schier II, ASME secretary, and Glenn B. Warren, outgoing 1959 president of the society

Fig. 1. Lieutenant-General James M. Gavin, former U. S. Army Chief of Research and Development, who is presently the executive vice-president of Arthur D. Little, Inc, delivers the Towne Lecture. He pointed out in his talk that preoccupation with missiles for military use only was as shortsighted as an earlier view of those who believed that the airplane should be used as a military vehicle exclusively

The current fuel situation and its future possibilities were well covered in papers and discussions. These included data on American and European coal characteristics, control of air pollution from oil-burning power plants, use of transparent scale models and design of dust-collector and gas-duct systems for coal-burning stations, and the like. Data were presented on boiler furnace explosions and protection of furnaces from such explosions. Recent practice in design of steam-generating equipment for public utilities and for industries was thoroughly covered, as was the work in metallurgy necessary for development of super-critical plants, such as that at Eddystone, and the feedwater purification problems of such plants. There was a panel discussion on corrosion in high-pressure boilers and the methods of combating it.

Discussion included an idea that removing dissolved oxygen from feedwater could possibly eliminate oxide corrosion. Importance of leakproof connections and seal designs was discussed. Also shown was the need for preventive chemical boiler-cleaning. Several sessions on boiler feedwater studies were held, including some important papers on steam sampling.

Included in the gas turbine sessions was discussion of the future possibilities of the combined gas-turbine and steam-turbine cycle to increase flexibility and efficiency.

A fine economic analysis of peak-shaving and its importance to the utilities aroused much interest.

In the nuclear power sessions, an outstanding feature was the discussion of a new method of pressure containment for nuclear reactors to promote safety and greatly decrease reactor costs.

The hydraulic sessions included a good discussion of cavitation of pumping machinery and cathodic protection for it.

Solar energy was discussed at some lengths with data on design of a solar turbo power plant, review of important solar energy developments in Japan, and data on solar air conditioning.

A new fluid-flow measuring device, the Twin-Throat Venturi, was described, along with other recent developments in measurement and control practice.

Many members took trips to the National Aviation Facilities Experimental Center, the Brighton Florists, and the Owens-Illinois Glass Co plants. There was also a complete program for the ladies attending the meeting. THE END

CONSTRUCTION NEWS

Phoenix, Ariz. — Arizona Power Authority has announced filing with the Federal Power Commission a revised proposal for a $347,300,000 hydroelectric project on the Colorado River. Project proposed would have an initial generating capacity of 820,000 kw with possible future installation of an additional 650,000 kw. Under the revised plan, the Bridge Canyon Dam would be 1520 ft long, 480 ft high. The reservoir would have a storage capacity of 820,000 acre-ft. Powerhouse would contain four generators each with an initial capacity of 120,000 kw.

Los Angeles, Calif. — Southern California Edison Co, 601 W. Fifth St, has plans under consideration for the rental from the Minneapolis-Honeywell Regulator Co, also of this city, of an all-transistor computing system able to prepare and process 25,000 customers' bills per day. Company spokesman said computer will be installed in a new building now under construction at a cost of $4,000,000 and scheduled for completion by the summer of 1961. Additional units will eventually be capable of processing bills for all of company's 1,600,000 customers.

San Jose, Calif. — General Electric Co, 1 River Road, Schenectady, N. Y., has authorized plans for a major expansion program in the San Francisco area of operations. Plans include a $2,000,000 expansion of the company's atomic power equipment department here where company plans to erect a new headquarters building. Company will install a new computer in its present facilities and will add another research laboratory to its facilities at Pleasanton, Calif. New laboratory will make possible special studies in the nuclear field and will also work in conjunction with the Vallecitos atomic laboratory near Pleasanton. New facilities are expected to be completed by fall and will add about 350 persons to present 1400 total.

Rowe, Mass. — Yankee Atomic Electric Co has announced that installation of the first fuel element assemblies for its power plant here are about to get under way and are ready for shipment from the Westinghouse Electric Corp plant in Pittsburgh, Pa. When completed late in 1961 new plant will have a capacity of 134,000 kw and will have 76 of these units within its pressurized-water reactor. Each assembly, about eight ft long and eight sq in., is composed of 304 stainless steel tubes, each of which contains 150 pellets of slightly enriched uranium oxide. New station will represent an investment of about $50,000,000.

Natchez, Miss. — Armstrong Tire & Rubber Co, 475 Elm St, West Haven, Conn, has plans under consideration for the construction of large manufacturing addition to its facilities here, for the manufacture of tires and tubes. Work will begin when preliminary engineering work is completed, on a 300,000-sq ft manufacturing addition, warehouses, office building, steam plant, and other production buildings. Plant when completed in early 1961 will cost an estimated $3,000,000.

Lesterville, Mo. — Union Electric Co of Missouri, 315 N. 12 Blvd, St. Louis, Mo, has announced plans for the construction of a large "pumped-storage" power plant, near here, capable of producing 350,000 kw a day for the St. Louis area. Only two other such projects are under construction in the world at the present time. One is at Niagara Falls, N. Y., and the other is in Great Britain. Union Electric's project, to cost about $50,000,000, is to be the largest of the three. Actual construction work is expected to provide jobs for about 1,000 persons and will begin soon for scheduled completion by the summer of 1963.

Emerson, Neb. — City of Emerson, Nebraska, City Hall, has authorized plans for power-generating plant additions, building alterations and extensions, increased generating capacity, cooling system, and switchboard alterations at municipal electric plant. City has awarded contract for the work, which will cost a reported $113,539.

Newark, N. J. — Public Service Electric and Gas Co, 80 Park Place, Newark, N. J., has announced contract award to the Westinghouse Electric Corp, Pittsburgh, Pa., for the installation of a 325,000-kw cross-compound steam-turbine generator at its Sewaren Generating Station, near Perth Amboy, N. J. Work on the installation of the new unit will begin soon for scheduled operation in the spring of 1962 and will increase power plant's capacity by better than 75 per cent.

Brentwood, L. I. — Long Island Lighting Co, headquartered at Mineola, N. Y., has announced the opening of its huge Brentwood operations center here as a physical indication of the growth of Suffolk County. The new $3,000,000 service center, second only in size to the 77-acre operations center at Hicksville, L. I., will service all of central and western Suffolk County. Full site, covering 25 acres, has outside storage areas for poles, cable, transformers, and other equipment.

Raleigh, N. C. — Carolina Power & Light Co, 419 Fayetteville St, has announced plans on the construction of a 110,000-volt electric transmission line from Sumter to Kingtree, S. C. Work, to cost an estimated $100,000, should be completed this summer.

Cincinnati, O. — Cincinnati Gas & Electric Co, Fourth & Main sts, has announced plans for a major expansion and addition to its Walter C. Beckjord Power Station, located 22 miles east of this city. Plans call for the construction of a 250,000-kw coal steam-generating unit, the fifth at the Beckjord Plant and the largest in the company's system, which now has a total capacity of 1,475,000 kw. New installation will cost $50,000,000. Some $40,000,000 of the planned outlay will go for the generating unit itself and about $10,000,000 for additional transmission and distribution facilities. Work is under way and unit is scheduled to go into service in the fall of 1962.

Oklahoma City, Okla. — Oklahoma Gas & Electric Co, 321 N. Harvey St, has requested the Oklahoma Corporation Committee to approve a plan whereby Yukon Electric Co, Yukon, Okla, would be merged with the Oklahoma City-based utility. Application stated that the Yukon Electric Co would receive 11,700 shares of Oklahoma Gas & Electric Co common stock in the merger. The Yukon firm has an electric generating plant reportedly worth about $375,000, about 20 miles of distribution lines.

Saxton, Pa. — Pennsylvania Public Utilities Commission, Harrisburg, Pa., has granted permission to two Pennsylvania utilities to participate in the proposed construction of a nuclear generating station to be located here. The Commission gave Metropolitan Edison Co, Reading, Pa., and the Philadelphia Electric Co, Philadelphia, Pa., authority to acquire stock in the newly-formed Saxton Nuclear Experimental Corp, of Reading, Pa. Company has pending before the Atomic Energy Commission an application for a permit to build a 5000-kw plant. Plant will be of the water-type reactor and will be located in a sparsely populated area in a mountainous region of Bedford County. Cost reported to be about $8,500,000.

University Park, Pa. — General State Authority, 18th and Herr sts, Harrisburg, Pa., has authorized plans for a large new nuclear facility for nuclear study and research, including hot cells, work rooms and laboratories at Pennsylvania State University, located here. Work is to include a three-story concrete, steel structure to house accelerators, a two-story nuclear science laboratory at a cost in excess of $1,200,000. Other work is to include a physical education building and an electrical engineering building. Utilities extension and revisions will cost a reported $8,000,000.

Knoxville, Tenn. — Tennessee Valley Authority, New Sprankles Bldg, Knoxville, Tenn, has announced contract award to the American Elin Corp, 11 Broadway, New York, N. Y., in the amount of $2,139,240, for three 32,400-kw hydroelectric generating units to be installed on the Authority's Wheeler Dam project located in Alabama. Construction work is now in progress and will be completed sometime by mid-summer of 1962.

Richfield, Utah — Garkane Power Association has plans under consideration for the construction of a 69-kv transmission line to be run from Escalante to Henrieville, Selver County, Utah. Work will begin when preliminary work of the engineers is completed. Contract for the work has been let to the Bonneville Construction Co, Idaho Falls, Idaho, for a consideration reported to be about $200,000. Line will be completed in the fall.

Carbo, Va. — American Electric Power Corp, 30 Church St, New York, N. Y., has authorized plans for the expansion of its Clinch River plant located here. Plans include installation to the power plant of a third generating unit with a capacity of 225,000 kw at an estimated $28,000,000. Construction has just begun and is scheduled for completion by late 1961.

Washington, D. C.—Atomic Energy Commission, 1901 Constitution Ave, N. W., has announced that it has assigned the job of developing a simplified nuclear power plant for naval ships to its Knolls Laboratory at Schenectady, N. Y. This laboratory is operated by the General Electric Co, headquartered here. Development of what the commission described as a natural-circulation, pressurized-water reactor plant for naval ships propulsion will cost in the neighborhood of $18,500,000.

Power Engineering handbook

Know the Basic Facts About Welding?

Here's the beginning of a streamlined summary we will publish from time to time, from Welding Fundamental Principles and Practices, a National Technical Training Services course

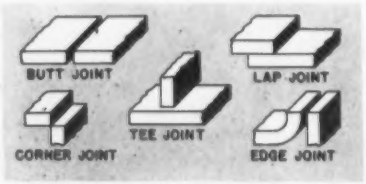


Fig. 1. There are five basic joints in welding

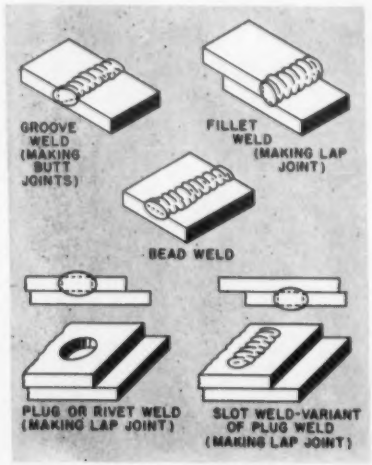

GROOVE WELD (MAKING BUTT JOINTS)
FILLET WELD (MAKING LAP JOINT)
BEAD WELD
PLUG OR RIVET WELD (MAKING LAP JOINT)
SLOT WELD-VARIANT OF PLUG WELD (MAKING LAP JOINT)

Fig. 2. Variations on the three basic weld types

WELDING consists of joining two or more pieces of metal by the application of heat and sometimes pressure. In arc welding, the heat comes from an electric arc and no pressure is employed to fuse the metal parts. Sometimes the heat from the arc is used to melt and fuse the parts together without adding extra metal. In most applications of arc welding, however, molten metal is added to the joint, and usually this joint is specially prepared like a mould to receive such metal.

There are only five basic joints, although many variations of these result from the manner of preparation and assembly. These five (Fig. 1) are termed butt joint, corner joint, Tee joint, lap joint and edge joint.

There are only three basic welds. They are groove, fillet and plug. These terms are somewhat descriptive of the joint and the weld. Many variations are possible.

All welds are composed of one or more beads. A bead is a single run or pass of weld metal. A bead or beads may be used to build up a surface and need not necessarily be used for making a joint. When it is so used to "build up," "layer" or "butter" a surface, it may be

fold along this line—outside edges toward you

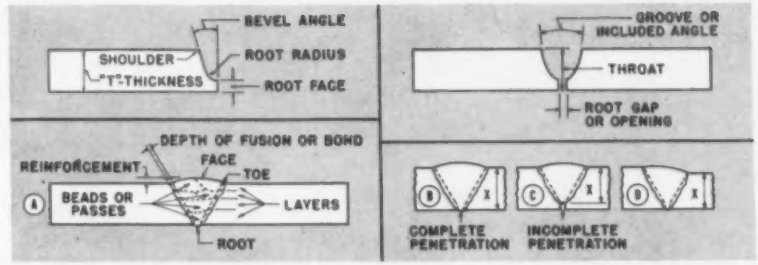


Fig. 3. Joint and weld nomenclature or terms. Weld size (x) is defined in sketches B, C and D. Where penetration is incomplete (C), weld size is depth of fusion. Where plates differ in thickness (D) and penetration is complete, weld size is considered to be the thickness of the thinner plate. Bead is a single run

termed a "bead weld," thus making, in a sense, a fourth type.

Groove Welds

As the name implies, the joints for such welds are in some manner prepared to form a groove or crucible to receive the weld bead or beads. There are five types — square groove, V-groove, bevel groove, U-groove and J-groove.

In Fig. 4 the various types of groove welds are all shown as applying to butt joints. Some or all of these welds are applicable also to corner joints, Tee joints, lap joints and edge joints.

Plug Welds

A descriptive term for this weld is rivet weld. They are employed chiefly for lap joints but may be used for Tee joints on thick plate where a fillet weld is not adequate or is not possible due to inaccessibility. When a slot is made, rather than a circular hole, the weld is called a slot weld. It is a form of plug weld.

In all cases a hole or slot is punched, drilled or flame-cut in one plate and a weld made through it to the underlying plate joining the two by a fillet weld around the periphery of the hole or slot. The hole or slot may or may not be entirely filled in with weld metal.

Tack Welds

These are short, sometimes temporary, welds used to assemble parts and hold them in alignment for final welding. They are spaced at intervals along a joint and usually consist of only one bead.

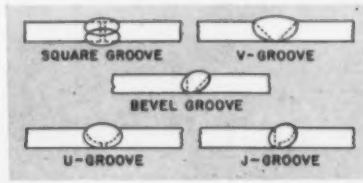


Fig. 4. Various types of groove welds are shown here as applying to butt joints. These joints are permitted unrestricted use, provided root of weld is chipped out to sound metal before opposite side of joint is welded, with exception of the bevel and J-grooves in some positions of welding where access to joint is limited in some way

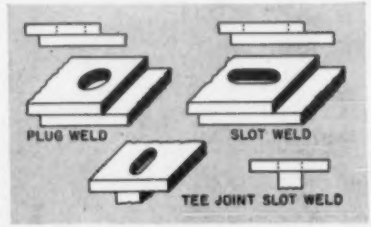


Fig. 5. Plug and slot welds. The hole or slot may or may not be entirely filled with the weld metal

Continuous Welds

Welds that continue without break throughout the length of a joint are called continuous welds. Welds are made continuous unless otherwise specified.

continued next page

POWER ENGINEERING HANDBOOK

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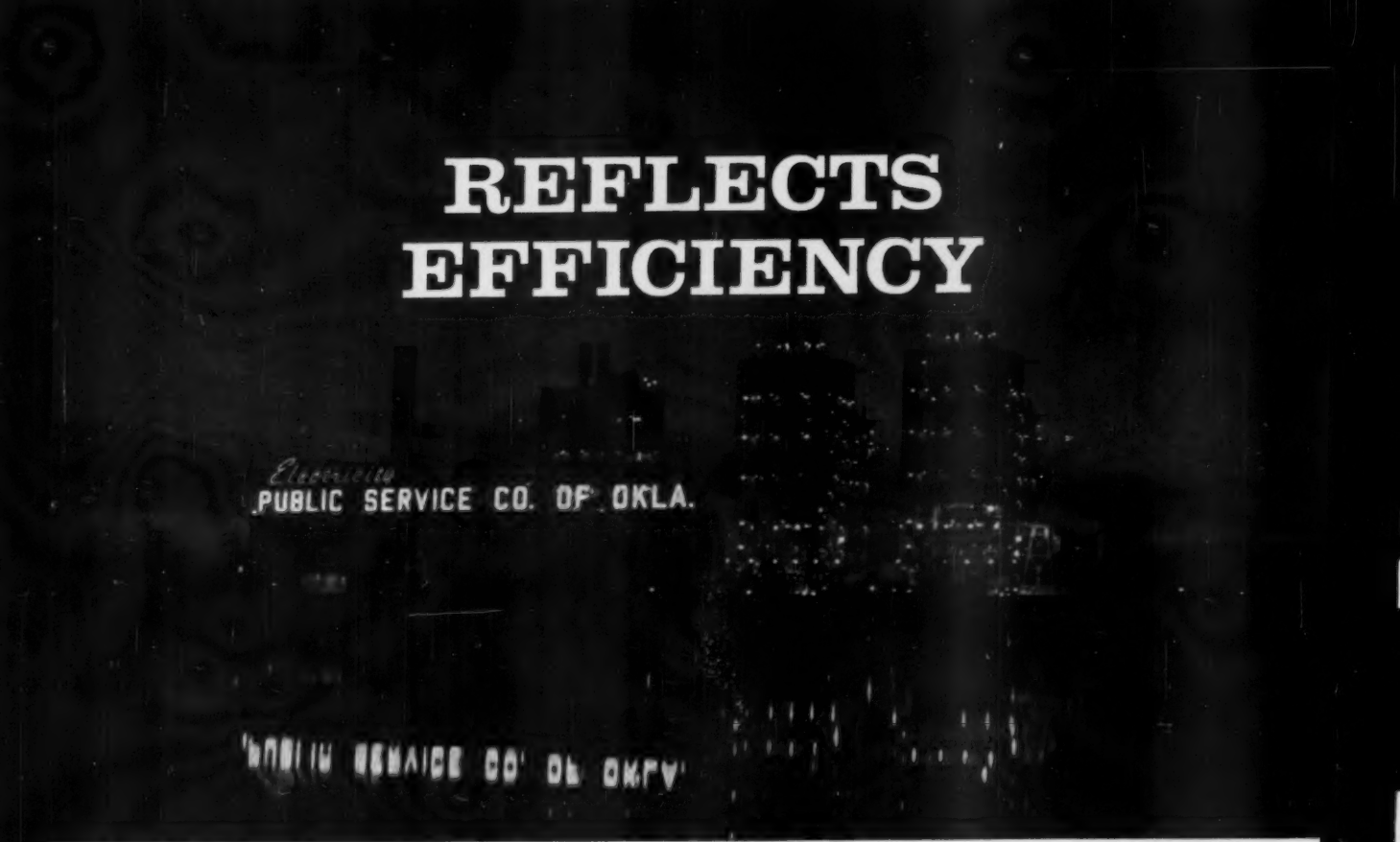
REFLECTS EFFICIENCY



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PANALARM "flashing-ringback sequence" Recording Annunciator System converts raw data into usable information in seconds—a tremendous improvement over slow, old fashioned manual logging. Costly outages are fewer because of the speed and reliability with which off-normal conditions are registered.

The Recording Annunciator System sounds an alarm when trouble occurs. Simultaneously, it prints an accurate alpha-numeric digital record of the date and time of trouble and identifies the equipment that failed and/or returned to normal, eliminating possibility of operator error.

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For an optimum competitively priced Recording Annunciator System for your plant, talk to Panellit engineers. Sales and engineering offices in all principal cities.

PANALARM ANNUNCIATORS record critical information on 7 turbine generators related to differential shutdown, overvoltage, ground detection, motor control, loss of field, pressures, temperatures, and shutdown or bus tie transfer operations.

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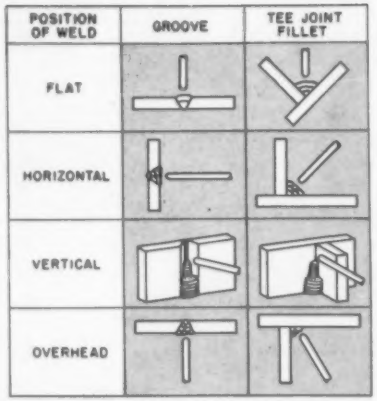


Fig. 6. This chart shows positions of welds for groove welds and fillet welds made on a Tee joint

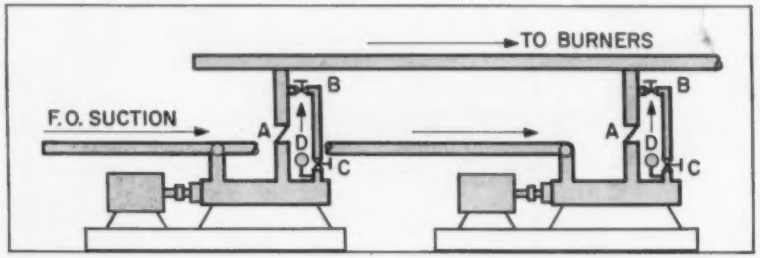
Intermittent Welds

Such welds are short welds, usually of equal length (2 in. to 12 in. generally), spaced at equal intervals along a joint.

Positions of Welds

With metallic arc welding it is possible to deposit metal in any position so that an operator may make a joint that is below him, in front of him, above him, or at any intermediate position between these three.

A weld is said to be made in the flat position, horizontal position, vertical position or overhead position, depending on the position of the joint in relation to the floor. Techniques for the four positions of welding vary according to the ease of depositing metal. It is possible to deposit weld layers of considerable volume in the flat and vertical positions, but stringer beads are normally used for horizontal and overhead welding. See Fig. 6.



Pipe is installed from discharge side, after check valve A, to pump discharge pressure gage connection

Keep That Idle Fuel Pump Warm

By CONRAD T. HEBERT

IF YOU'RE USING DeLaval IMO pumps on rotary gears for your fuel oil pumping system, here's a good way to keep the idle pump warm and ready for instant use.

Install a ½-in. or 1-in. pipe from discharge side of the pump after the check valve (A, in sketch) to pump discharge pressure gage connection by use of a T-fitting. Include cut-off valve, B, and a micrometer valve, C.

On the idle pump, open valve B wide, and throttle valve C, so that oil from high pressure side is being bled back to discharge side of pump by bypassing the check valve. Regulate valve C so that enough oil will pass through the pump and on to suction side. In some cases the pump will run backwards a few rpm's.

fold along this line—outside edges toward you

Figuring Pipe and Other Cylindrical Surfaces

By JOHN D. CONSTANCE, P.E.

QUICK WAY to estimate pipe and other cylindrical surfaces is afforded by the use of this chart. Although its range is from 1-in. to 100-in. diameter, surfaces above this range may be calculated from the well-known simple equation: $\pi \times$ diameter (in.) $\times 1/12$, sq ft per ft.

Any occasion to determine surface areas of pipes and similar surfaces are hereby simplified. There is no need to refer to handbooks or other aids. Chart will be useful for figuring pipe and vessel covering and insulation, paint quantities, heat transfer calculations and in other situations wherever surface areas must be known.

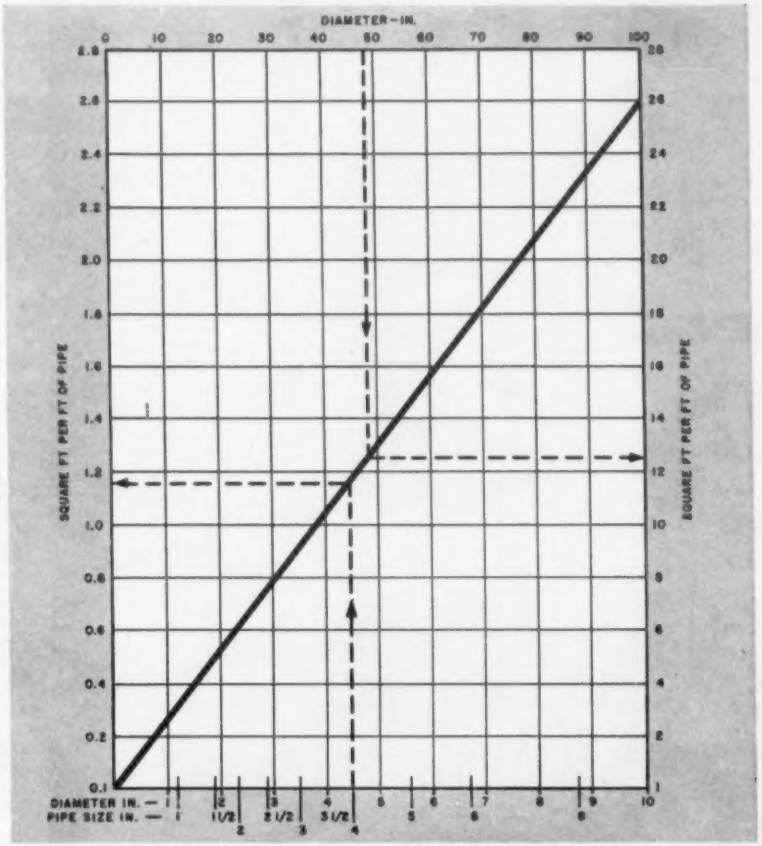


Chart showing surface area of pipe and cylinders, has range of from 1-in. to 100-in. diam surfaces

cut along this line

The Valley Camp Coal Company provides a complete combustion engineering service for its customers, actual and prospective.

Meeting with a Valley Camp Representative has been the first step to lowered steam costs for many companies . . . . . *How about yours?*

THE VALLEY CAMP COAL COMPANY

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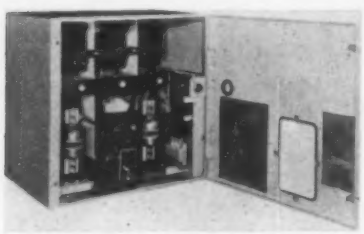
EQUIPMENT NEWS

Described on these pages are new and improved products. Use Reader Service Cards on pages 109–110 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

1—FUSE-BREAKER UNIT gives low cost circuit protection

Fusematic is a 600-v, 200,000-amp coordinated fuse-breaker unit designed to offer fault circuit protection at substantially lower cost than afforded by a conventional breaker alone. An integral unit combining components of conventional low-voltage power circuit breakers and current-limiting fuses, Fusematic is rated up to 1600 amp continuous and



200,000 amp interrupting capacity. Its primary application is for service entrance and feeder protection where high fault current exists. In this, it is said to offer faster interruption as well as better protection.

Being only 24 in. wide and 22½ in. high, Fusematic is a size equal to or smaller than conventional power circuit breakers of the same continuous rating; also it uses standard, commercially available fuses. Single phase protection is achieved by potential difference appearing across the terminals of the blown fuse, it is explained rather than by a striker pin fuse. Fusematic is available with manual or electrical (shown) operation, has a 1600-amp frame size and range of coil ratings from 200 to 1600 amp. Federal Pacific Electric Co.

2—RECORDING CHART PAPER inkless, heat sensitive

Heatrace is claimed to produce faster, more legible permanent tracings of oscillographic signals on recording devices and related instrumentation. Features announced for the heat-sensitive chart paper include greater sensitivity to hot stylus marking systems, more legible recordings of higher spot velocity traces, and lower stylus heat requirements. Heatrace comes in opaque and translucent grades for direct-readout and for reproduction of original traces. Chart Paper Sales Div., Nashua Corp.

3—ASBESTOS GASKET TAPE, double seal, in three types

This tape is offered for usages requiring a uniform gasketing that fits around bolts or studs to form an efficient double seal. With this tape, it is unnecessary to make two separate gasket applications on either side of bolts or studs, or to perforate broad gasketing before use. Three types available include: a plain wire inserted folded asbestos tape with open lattice, or bolt space, center; a plain wire inserted asbestos tape woven flat to desired dimensions and bolt space openings; and a plain woven non-metallic asbestos tape. All can be furnished plain or graphite coated, one side or both. Fibrous Products Div., Union Asbestos & Rubber Co.

4—AUTOMATIC APPARATUS keeps frost off the coils

The No-Frost Concentrator is designed to prevent frost accumulation on refrigerated coils of large-scale freezing and cold storage installations, with convenient disposal of condensed moisture. A non-freezing, hygroscopic liquid is sprayed over the cold coils of a fan cooler, absorbing the moisture as fast as the coils condense it. As this condensate water dilutes the absorbent solution to the point where freezing becomes possible, its strength is restored by the concentrator. It adapts a submerged electric water heater to provide sufficient heat to evaporate the water while the reconcentrated liquid is returned to its frost prevention duty. Operating at the low temperature used, the equipment is claimed to avoid fire hazards, to be easily cleaned and to reduce chances of operational failure. Four sizes afford a capacity range sufficient for largest systems. Niagara Blower Co.

5—PACKAGED DEMINERALIZER is quickly installed unit

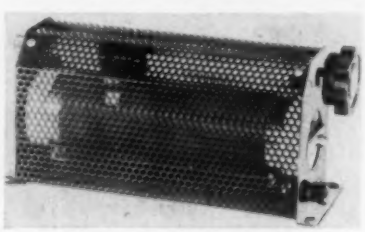
On-site erection of the Uni-Pac M series of demineralizers consists of setting the unit in place and connecting to air and raw water supply, treated water outlet, and open drain. Only electrical connection required is for a conductivity controller, which uses 110-v 60-cycle current from a standard lighting outlet. Models are available in capacities from 2100 to 13,200 gph using raw water with 10 grains per gallon total exchangeable anions. Operating valves and piping are PVC and exchange tanks are lined with it. Auxiliary polyethylene regenerant tanks are provided for acid and alkali. The units have conductivity and rate-of-flow indicators. Cochrane Corp.

6—SIGHT GLASS INDICATOR, aluminum, straight-through type

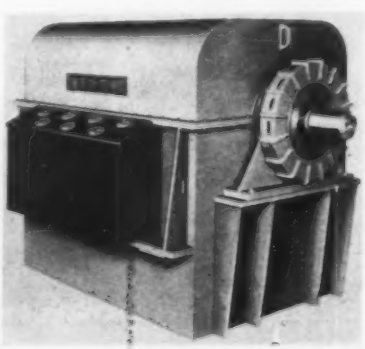
Now available in aluminum, Model 640 Visi-Flo Sight Glass Indicator is used in gravity flow applications, to indicate direction, viscosity, color, clarity, rate of flow and purity. It is designed to handle entrained solids, gasoline, oil, water or chemicals. Model 640 is straight-through type with double windows of heavy plate glass on opposite sides with leakproof gaskets, in ½ through 2 in. sizes, for pressures to 75 psi, temperatures to 225 F. Prices range from under $12.00 to around $21.00. Bulletin F-6 gives information on the indicator. OPW-Jordan.

7—CAGED RHEOSTATS offer greater operator safety

Because their metal cages enclose live and hot parts, the 10-in. Lubri-tact Screw-Drive Caged Jagabi Rheostats provide maximum safety to the operator, it is announced. The cages are attached to pre-punched end brackets and

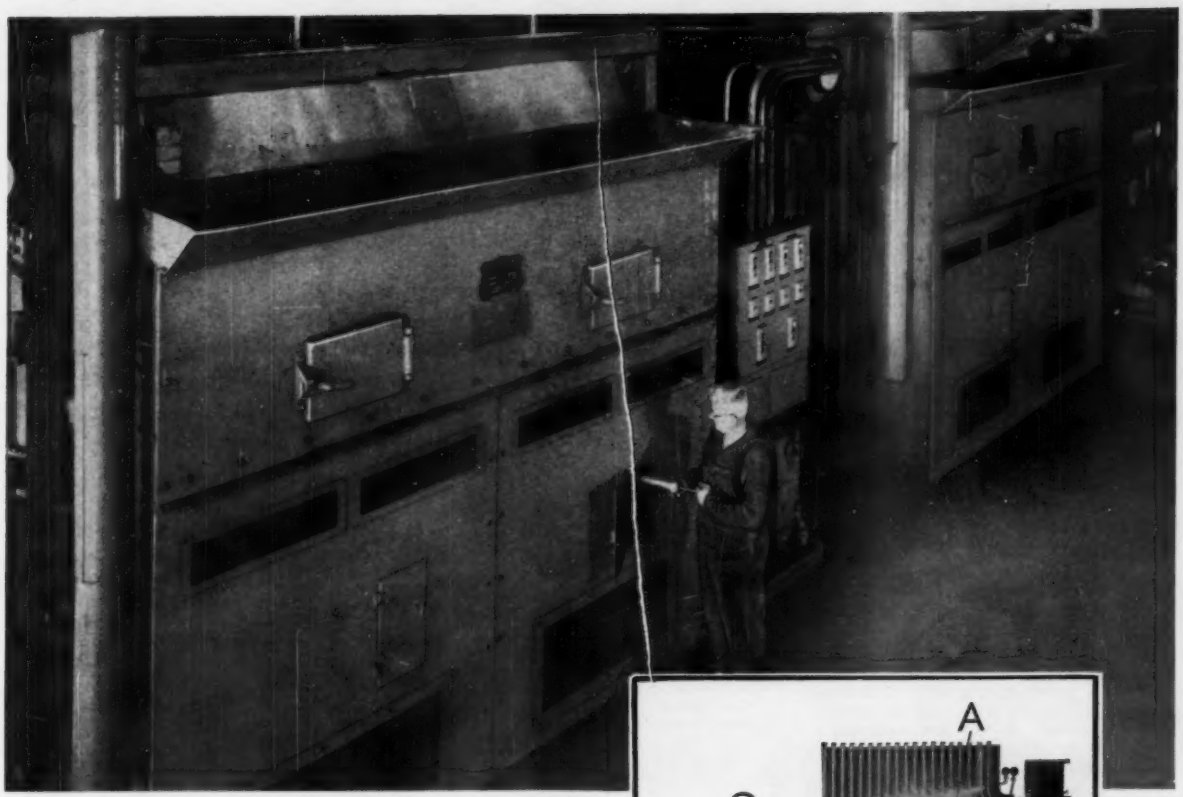


enclose top, sides and bottom of the rheostats. The perforated material used allows 50 per cent more open area than older types, manufacturer points out, affording better cooling. An additional convenience is in the cages themselves which can be added in the field. Mounting dimensions are the same as for open rheostats, varying only in the slight increase in slider height. Details are in Bulletin 41-24. James G. Biddle Co.

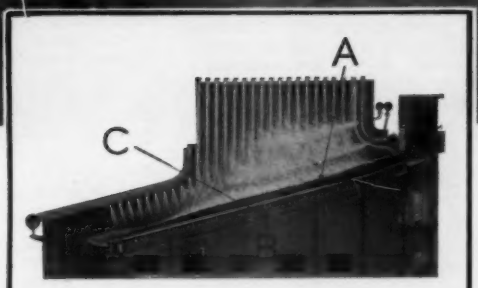


8—ADJUSTABLE DRIVE for "on the shaft" boiler feed pumps

Type VS, Class 7, a line of adjustable speed Gyrol Fluid Drives, is introduced for use with "on the shaft" boiler feed pump drive arrangement, in which the feed pump is driven directly from the main turbine generator shaft. The units are designed to provide a stepless, infinitely adjustable speed control — a feature saving power over entire operating range. These drives are available for use with any size boiler feed pump. Standard units are for 3600 or 1800 rpm operating input speed. Drive shaft height is matched to centerline height of main turbine shaft for the simplest of floor



The only preventive maintenance required on a Vibra-Grate Stoker is for a mechanic to grease it every three months at four points on the front.



With AE Vibra-Grate Stoker, intermittent agitating action feeds coal down inclined grates (A) at controlled rate. This automatically levels fuel, eliminates spotty burning. Separate zones (B) permit exact adjustment of forced draft air for proper combustion at all stages of burning. Water-cooled grates (C) virtually eliminate maintenance. Stoker feeds wet or dry coal of any grade. Water-cooled grates permit burning gas or oil without damage to grates. Quick conversion from or to coal now possible.

AT SPAULDING FIBRE COMPANY
(makers of ARMITE, SPAULDITE fibres and plastics)

Vibra-Grate Stokers save 1000 tons of coal per year!

The two 50,000-lb AE Vibra-Grate Stokers shown above went on line at the Tonawanda plant of the Spaulding Fibre Company in 1958.

Cost and performance data for the two-year period to January 1960 are reported as follows:

Total coal consumption (both units) 26,472 tons; an estimated savings of 2,000 tons compared with other stokers in the same plant. Superior air zoning increases combustion efficiency at all loads. Average evaporation on one unit is 10.6 lb of steam per pound of coal and 10.8 on the other, using coals having an average Btu value of 13,173.

To cap it off, the company reports maintenance costs are much lower than those of other types of stokers in service, and . . . "efficiency and operating economies far in excess of the manufacturer's guarantee and our highest expectations."

In every installation, and under the most critical observation, time and usage are proving the peak efficiency, and the almost total elimination of maintenance costs, possible with the exclusive AE Vibra-Grate Stoker design. No other stoker combines the advantages of vibrating grate feed, water-cooled grates and precision-controlled air zones. **Write to Dept. S-101 for copies of plant operating reports and AE Vibra-Grate Stoker Catalog S-546-A today.**

AMERICAN ENGINEERING COMPANY
Wheatsheaf Lane & Sepviva St. • Philadelphia 37, Pa.

Canadian Subsidiaries: Affiliated Engineering Corporations, Ltd., Montreal, P. Q. • Bawden Industries Ltd., Toronto, Ont.

For more data circle 544 on Post Card

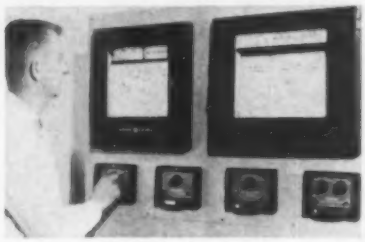
mountings. The unit is designed for below-floor installation of auxiliary cooling equipment and related piping. Industrial Div., American-Standard.

9—PROPORTIONING PUMP handles corrosive chemicals

Model 1331 Proportioneers Chem-O-Feeder is a low cost, electrically driven unit for proportioning of concentrated corrosive chemicals. Of corrosion-resistant materials, this diaphragm pump is designed to meter such chemicals as 66 deg Baume sulfuric acid, sodium hydroxide, phosphoric acid, photographic solutions, hydrofluosilicic acid. The positive displacement pump features adjustable stroke length while in motion. It can be installed on the floor, wall or shelf mounted, and takes suction directly from shipping container. The complete unit consists of pump, foot valve, injection nozzle, hoses. It is suggested for chemical and air conditioning as well as for general industrial application. B-I-F Industries, Inc.

10—SUPERVISORY SYSTEMS are smaller, faster scanning

These steam turbine supervisory instrument systems are reported to scan signals faster and require about 65 per cent less panel space. The improved systems will be supplied with new steam turbines above 100,000 kw, and made available for smaller new units and steam turbines now in operation. Size



reduction of a typical panel area is from 18 to 6 sq ft, made possible by recording all data on two strip chart records instead of the previous four, and by substantially reducing the size of the power units.

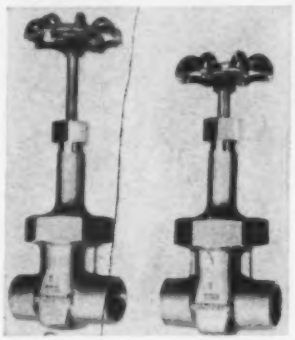
One recorder — a duplex ink-writing model — records speed or valve position and shaft eccentricity. The other is a multi-point recorder that prints shell and differential expansion and shaft vibration. With this data recorded on two adjacent strip charts, operators can inspect operation and interpret trouble sources more easily. The multi-point recorder scans and records every 5 sec. On a turbine having eight shaft vibration detectors, data from each is recorded every 40 sec, instead of every 15 min as on former models. Up to 16 detectors can be scanned in sequence. General Electric Co.

11—MAGNET PULLEYS in large diameter sizes

Indox-V permanent magnet pulleys, in diameters from 12 to 48 in., are introduced for heavy-duty tramp iron material and cobbing applications. With them, advantages of low-cost permanent magnet pulleys can be utilized in coal-burning power plants. Indox V is described as a highly oriented barium ferrite ceramic magnet material providing pulley performance equal to most powerful electromagnetic types at much lower cost, and requiring no coils, rectifiers. Stearns Magnetic Products.

12—BRONZE VALVES, solder joint, rising stem type

These solder joint, bronze valves, with union bonnet and rising stem, are available in ⅜- through 3-in. sizes, and have a pressure rating of 125 lb. The union



bonnet eliminates distortion caused by mechanical strain or temperature changes, manufacturer points out. Except for the body, all parts are interchangeable with company's screwed-end 125-lb, rising-stem gate valve of the same size. Walworth Co.

13—PURGE METERS, low capacity, tough industrial jobs

Design of these glass tube purge meters includes features which make them suitable for purge, liquid level control or other applications. Metering tubes are 3-in. or 1½-in. scale, and give a direct reading in gallons per hour of water or standard cubic feet per hour of air. Except for the metering tube and frame, all parts are interchangeable, regardless of scale length. The metering tubes and floats cover a flow range of 0.01 to 30.0 gph of water, or 0.12 to 125.0 scfh of air. A stainless steel spring which holds the metering tube assembly in place is external; fluid being metered cannot come into contact with it, and cause it to corrode. A differential regulator, available as an accessory, controls pressure drop across the needle valve, and not across entire meter. Technical Publication TP-1-RM gives information. Wallace & Tiernan Inc.

14—DUST COLLECTOR for high temperature control applications

Developed specifically to solve air pollution problems arising from high temperature fume and dust emissions, the Type CO Cloth Tube Collector is designed for use with glass filter fabric, although said to perform equally well with other filter fabrics. Use of glass permits filtration at temperatures to 550 F. Dust is collected on the inside surfaces of the filter tubes which are cleaned by means of short blasts of higher pressure air from jets inside each tube. These are alternated with a small amount of reverse airflow from the main fan and this partially collapses the tubes, cleans the filter surfaces and deposits the residue into storage hoppers.

Intensity of cleaning action may be regulated from a slight pulsation to the equivalent of mechanical shaking. According to manufacturer, maintenance is reduced by this type of cleaning action because there is less filter tube wear; and since there are no internal moving parts, there is no stress and strain on casing and structural members. The collector is controlled by an adjustable electric program timer. Pangborn Corp.

15—FLEXIBLE EPOXY TAPE with high electric strength

This electrical tape, X-1099, is announced as a pressure-sensitive tape with a backing of fully-cured, flexible, epoxy resin reinforced with glass cloth. Because of its high resistance to cold flow, good conformability, high electric strength and physical properties it is suggested for applications requiring electric strength of a continuous film of epoxy resin and physical strength of glass cloth at Class F operating temperatures. Minnesota Mining and Mfg. Co.

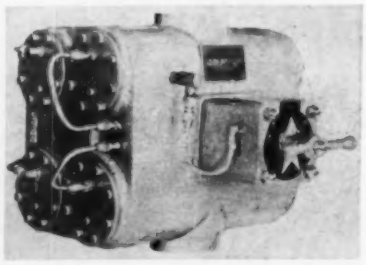
16—CALCIUM BATTERIES are light and space saving

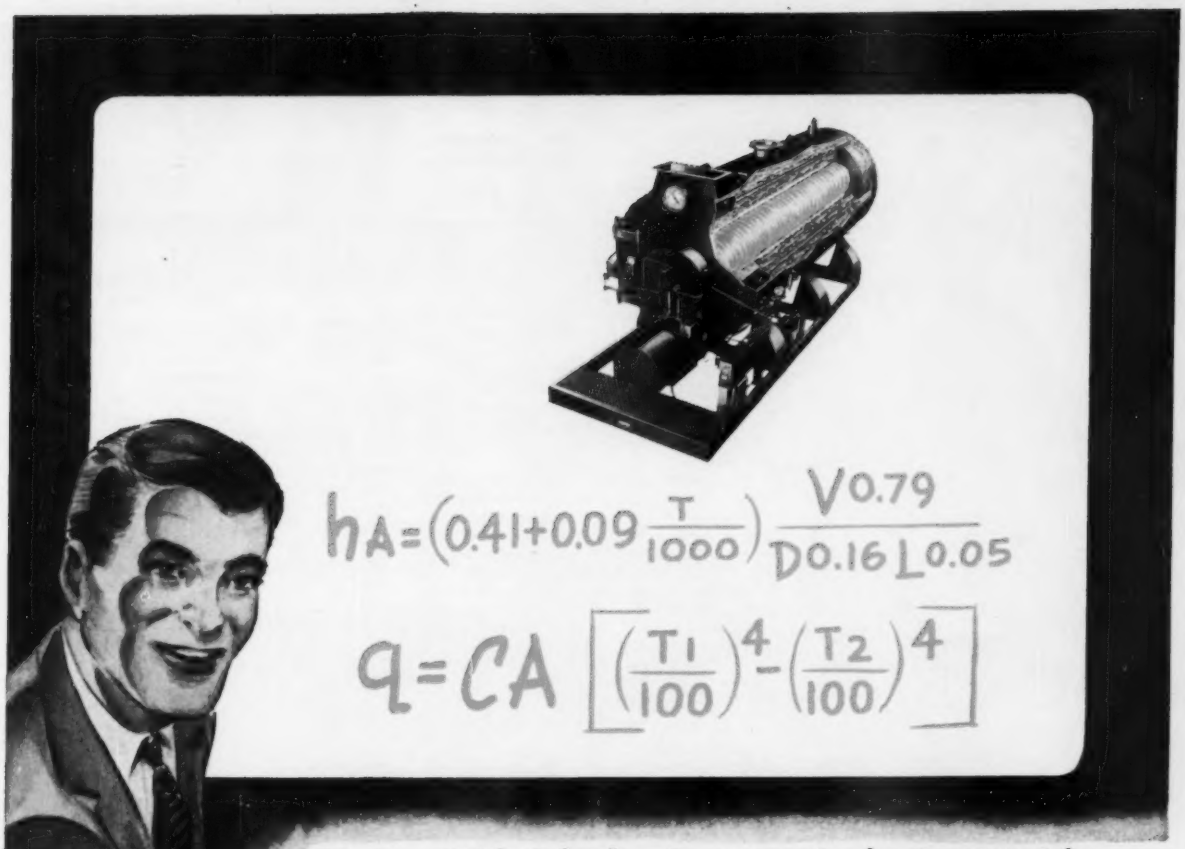
These lightweight, stationary batteries are suggested for switchgear, alarm system, telephone, control, signaling, emergency light and other applications where batteries are used as stand-by emergency power. For full float service, the calcium batteries are available in 50- to 1140-amp-hr capacities. The rugged Plastrite jar utilized is designed to save 30 to 40 per cent of floor space, permit increased battery room capacity and reduce storage rack requirements. Easier to handle because of its lighter wieght, the high impact resistant plastic container will not bulge or warp under heat, manufacturer states. Other features announced include improved electrical characteristics, and acid-proof seal, and an integral molded ledge on each end of the jars to support element weight and prevent breakage of plastic cover. Gould-National Batteries, Inc.

17—CONTROL VALVE for water treating equipment

Monotrol is a single control valve for directing flow of liquids in zeolite softeners, ion exchange units and filters. Designed to perform functions of a nest of individual valves while providing easier operation and maintenance, it comes in cast iron (shown) or acrylic plastic and can be manual or automatic.

Features announced are pilot control, positive hydraulic pressure actuation and easy maintenance. Internal parts can be removed without dismantling





Here's a Quick Refresher Course on Combustion Principles . . .

A Cyclotherm Sound Film-Strip that you and all your engineering friends should see

Every engineer interested in combustion should be sure to see the Cyclotherm sound film-strip, *Heat Transfer and Cyclonic Combustion*. Written by engineers, from a professional, not a promotional, point of view, this film is a quick refresher course in the principles of boiler engineering. *For engineers only* – too many mathematical formulae for the man-in-the-street to follow.

Cyclotherm has also prepared a manufacturing film which shows, step by step, how Cyclotherms are built. Beginning with the flat plate arriving from the steel mills and finishing with the complete boiler shipped to the customer, this film illustrates what we mean when we say that "one manufacturing responsibility is behind the entire equipment."

We'll be glad to arrange for an early showing of both these films. Invite other engineers in your company, as well as members of any engineering group to which you belong. You can see each film in 20 minutes – and you'll find them 20 minutes very well spent. For full information, write us today.

YEARS AHEAD IN STEAM & HOT WATER GENERATION
CYCLOTHERM®
STEAM AND HOT WATER GENERATORS

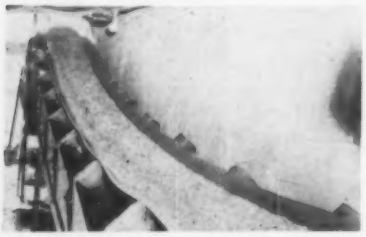
A Division of National-U.S. Radiator Corp. 50 E. First St., Oswego, N. Y.

For more data circle 545 on Post Card

the connecting piping or removing the valve from the unit on which it is used. The design is also said to provide for low pressure loss during operation and to prevent contamination of effluent. Graver Water Conditioning Co.

18—CONVEYOR BELTS for use with 45-deg troughing idlers

Greater payloads and other benefits of 45-deg troughing idlers for carrying all materials are announced for Ray-Man Conveyor Belt. According to manufacturer, this heavy-duty belt is particularly adapted for operating over 45-deg idlers. Its construction is doubly compensated so that the outer ply stretches



as the inner ply contracts under both lateral and longitudinal flexing, and even on reverse bends. Outer strength member plies are made with a high-strength synthetic fabric of controlled elasticity to relieve stress on the belt as it travels over idlers and terminal pulleys.

Advantages claimed for use of Ray-Man and 45-deg idlers include lower initial cost because narrower belts and conveyor equipment haul the same loads as belts on 20-deg idlers. Also, maintenance costs are lower because of less spillage, it is noted, and there is less wear on the belt. Bulletin M-303 gives data. Manhattan Rubber Div., Raybestos-Manhattan, Inc.

19—PLASTIC TAPE seals and lubricates pipe joints

Scotchrap Dry Thread Sealer 4212 is a chemically-inert tape designed to seal and permanently lubricate threaded and coupled pipe joints. This unfused film tape is said to go on quickly and con-

form to all types of pipe threads and fittings in any pipe system, low or high pressure. Applications include gas meter hook-up, oil casings, conduit, couplings, valve sealing, chemical lines. According to manufacturer, the Teflon resin tape withstands processing temperatures from the liquid-oxygen range through that of super-heated steam, and is unaffected by oil traces of other lubricants in the steam line. Although non-adhesive, the tape is claimed sufficiently cohesive to stick to its own glossy surface, as well as any pipe thread. Tape is white and comes ½ in. wide. Irvington Div., Minnesota Mining and Mfg. Co.

20—GENERATOR, fast steaming, uses fuel economically

Recently introduced in this country, the Henschel-Werke HK series of steam generators is claimed to produce 12 lb of steam with 1 lb of heating oil, make the steam within minutes of starting, and need only intermittent supervision. Units are designed to handle up to 170 psi, to turn out from 660 to 6600 lb of steam per hour (the higher capacity models are now under construction). They are oil fired (gas firing is in preparation), automatically controlled water-tube boilers. Model HK 300, producing 660 lb of steam per hour, holds only 29 gal of water, and no special boiler house is required.

The boiler consists of two assembly units: shell, and insert with heating surfaces and burner, a mechanical atomizer type. Flange connections between inner and outer boiler are confined to a single plane. Heating surface is formed by the jacket and bottom of the inner boiler and by the water tubes, vertically welded to the latter. Norca Machinery Corp.

21—LEVEL CONTROL for outdoor water storage tanks

With the "winter proofed" Model A-101 Magnetrol Liquid Level Control in outdoor water storage tanks is possible, manufacturer states, even though ice may form in the tank. A package unit, Model A-101 installs in outdoor tanks by means of a bracket mounting. Its switch housing is submersible and claimed unaffected by heavy humid atmosphere or complete immersion of the head itself. Inside, the mercury switch is protected against freezing both by vapor proof construction, and by a resistance heater to warm the housing.

It is explained that should the weather turn cold and 35 F be reached in the water in the aluminum tube around the displacers on the Model A-101 Magnetrol, a thermoswitch "cuts in" to supply current to the immersion heater in the tube. In this way, ice can form on the surface of the water in the tank, but the water inside the aluminum tube is kept free from freezing and, by radiation, a sufficient area around the tube, so that the displacers are always monitoring the true level of the tank water. Magnetrol, Inc.

22—AIR HOIST offers choice of throttle and brake systems

The JCP-120 is an air powered hoist which offers a choice of several throttle and brake systems to adapt it for use in a variety of applications, such as car spotting, barge spotting at docks, etc. Hoist has a lifting capacity from 27,000 lb at 37 fpm to 3,700 lb at 220 fpm. A five cylinder, radial air motor (10, 17 or 23 hp) with integral gear case drives the large rope drum through a multiple roller chain. Rope drum has a capacity of 2300 ft of ¾-in wire rope. For portability, entire assembly is mounted on a skid type base. Controls are mounted on the hoist, but can be removed and operated from a remote position. It can also be equipped with electric motor drive of 10 to 25 hp or air-cooled gasoline or diesel engine drive. Joy Mfg. Co.

23—SWIVEL JAW SPLITTER cracks tough nuts easily

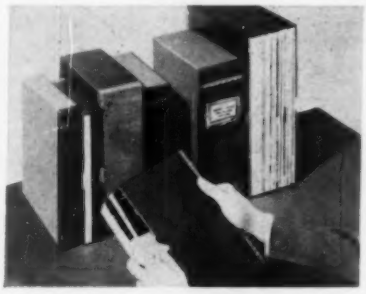
Stubborn "frozen" and rusty nuts can be reached, split and removed quickly, with the HKP Swivel Jaw Nut Splitter, according to manufacturer. The steel tool is designed to cut nuts up to, and including, ⅞ in. across flats. To operate, you place the swivel blade against the side of the nut, turn the power screw by hand until the jaw is tight against the nut, and then tighten it with a hand or power wrench until enough pressure is applied to split the nut. The tool won't damage the bolt, company states. H. K. Porter, Inc.

24—CANNED PUMPS designed for high pressure service

This series of sealless, leakproof "canned" pumps for high pressure service includes models for open flow capacities to 350 gpm, heads to 250 ft and temperatures to 1000 F. Standard units are for line pressures of 600 to 2500 psi, special units are for pressures to 5000 psi. Manufacturer says that these pumps retain advantages of "canned" construction — since pump and motor are one unit, there are no seals and/or stuffing boxes, no leakage. The pumps come in a variety of non-corrosive alloys. Though most are built for liquid service, leakproof vane pumps for gases at high static pressures are available. Chempump Div., Fostoria Corp.

25—FILE BOXES for your magazines, catalogs, reports

Manufacturers' catalogs, reports and other reference material can be filed neatly and safe from dust and damage in these low-cost sized-to-fit file boxes. They are covered with simulated leather material and look like hand-bound books. Files for magazines are imprinted in gold leaf with name of magazine and

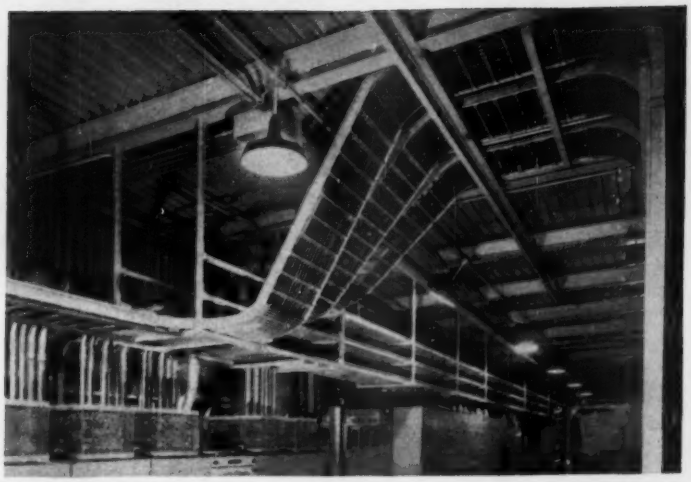


year of publication, with gold foil furnished for marking volume or issues. Files for reports are not imprinted, but supplied with reference card holder. Boxes sell for around $2.50 each. Edmund Scientific Co.

more Equipment News page 119

how INLAND STEEL uses GLOBE INTERCHANGEABLE TRAYS

to support cables in their Indiana Harbor Plant



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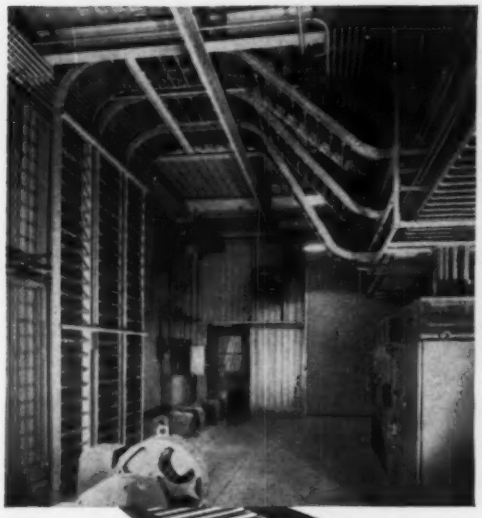
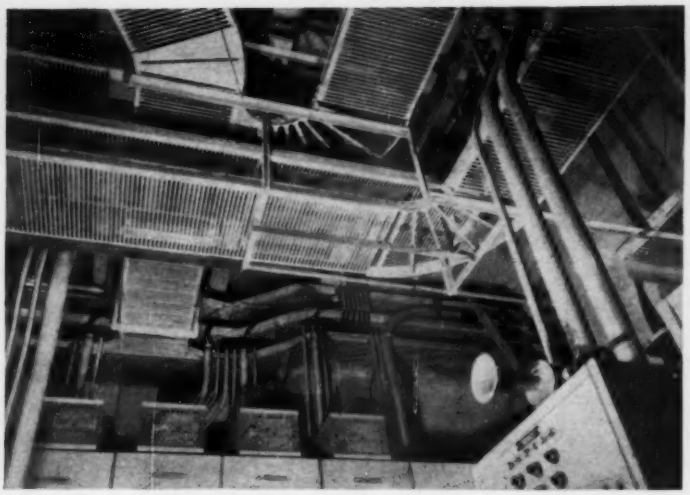
★ Complete Accessories for SPEEDIER Installation
★ Complete Interchangeability
★ No Sharp Edges to Damage Cables





Globe's two types of cable trays, one a ladder type and the other a basket type, to support cables, wiring and tubing have become increasingly popular because they can be used INTERCHANGEABLY at any given location depending on the type and weight of the cables to be suspended. The advantages of each type tray can be used to the fullest. Globetray, the ladder type, is intended for use where festooning is not a problem, while Cable-Strut, the basket type, is used for the support of communication wire, instrument tubing and control cables in automation applications.

These two cable trays have been thoroughly field tested in hundreds of large industrial installations, in new plant construction, in power plants and for power distribution in all types of manufacturing processes. Send for FREE catalog giving full information and installation techniques.

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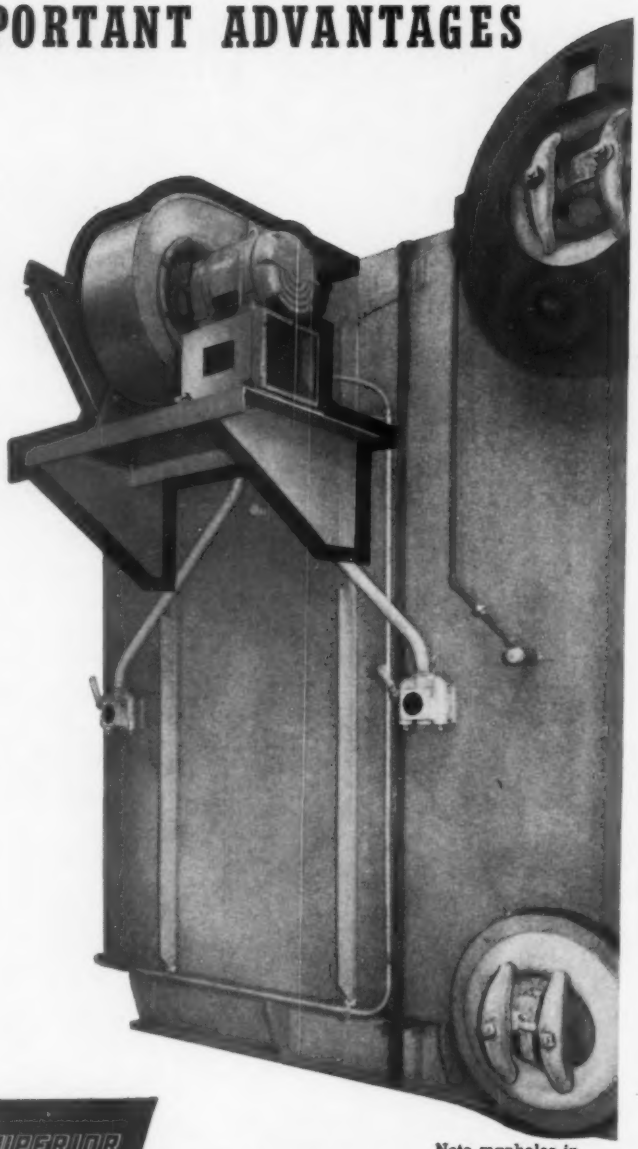
SUPERIOR'S rear-mounted DRAFT FAN

offers you 6 IMPORTANT ADVANTAGES

A distinctive and exclusive feature of Superior Water Tube Packaged Boilers is the rear mounting of the forced draft fan. *It is a quality feature provided by no other manufacturer.* Superior provides this proven and exclusive feature to achieve for its customers the following results which are not possible with any front-mounted-fan design:

1. An uncluttered, and much more readily accessible firing front.
2. Provides quieter operation as a result of lower air velocities between fan discharge and burner register, rather than the remote position of the fan.
3. The elimination of flame distortion by the equal distribution of air through the burner register from a plennum chamber.
4. The largest capacity units can be shipped with fan mounted in position . . . an integral part of the complete package.
5. Air-cooled and air-shielded observation ports which protect operator from pressurized furnace, eliminating the aggravation of the commonly used bulls-eye peep opening which is usually dirty and through which little or nothing can be seen.
6. The added safety of a rear-wall-mounted air-cooled scanner for flame failure protection of steam atomizing burners or for automatic gas firing with continuous gas pilot.



Note manholes in both rear drum heads.

Built, tested and shipped as complete packages, with integral firing equipment, draft fan, and controls to suit your operations, Type D Superior Water Tube Packaged Boilers provide economical steam production from 11,000 to 61,000 lbs. of steam per hour.

For complete details write for Catalog D- 12

SUPERIOR TYPE D

Specialists in PACKAGED BOILERS . . . exclusively

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VALVES, TRAPS, PIPING AND FITTINGS

201 Steel Valves — Catalog 14 contains over 90 pp of detailed information on company's line of cast and forged steel valves for power, petroleum, chemical and industrial applications. Provides ASA dimensions, pressure-temperature ratings and ASTM basic materials specifications, as well as curves and formulas for correlating valve size and pressure drop. Edward Valves Inc.

202 Valve Buyers' Guide — Detailed information on bronze, steel and iron valves, and valves made of corrosion-resistant metals and alloys is presented in 24-pp Form 186. Covers angle valves, check valves, gate valves, globe valves, liquid level valves, lubricated plug valves, needle valves, relief valves, sampling valves, steam jacketed valves and others. The Wm. Powell Co.

203 Safety, Relief Valves — Performance data on company's safety and relief valves is presented in 24-pp Catalog 1000-V. Steam, air and water capacity tables are included, as well as cutaway views showing component details, and dimension tables. J. E. Lonergan Co.

204 Silent Check Valves — Described in Bulletin WH-654 are silent check valves featuring low frictional resistance. Tables list dimensional data and reasonable velocities for flow of water through pipe, fittings, and valves. The Williams Gauge Co., Inc.

205 Diaphragm Control Valves — Three basic types of single seated diaphragm control valves are illustrated and described in 16-pp Bulletin 5304. Covers design and construction features, and includes materials tables, capacity data, and specifications. Leslie Co.

206 Ductile Iron Regulators — Bulletin J-DI describes characteristics and advantages of ductile iron regulators and control valves which combine strength of steel with corrosion resistance of cast iron. Composition, properties, specifications, comparison tables on steel, cast iron and red brass, and test results are covered. OPW-Jordan.

207 Insulated Piping — Described in 20-pp Catalog 59-1 are prefabricated insulated piping systems for underground and overhead use. Cutaway views showing design and construction features are included as well as dimensional diagrams and data, and photos of typical applications. Ric-wiL, Inc.

208 Flexible Hose, Bellows — Sixteen-pp Catalog 187 describes applications and use of flexible metal hose and bellows. Engineering specifications and sizes, pres-

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sure ratings, materials and fitting attachments are included. Detailed drawings and pictures facilitate specifications of individual applications. Flexonics Corp.

209 Expansion Joints — Twelve-pp Bulletin EJ-1917 describes advantages of company's Gun-Pakt expansion joints with either welding or flanged ends. Section on figuring expansion of pipe lines, expansion joint installation suggestions, and complete specifications are included. Yarnall-Waring Co.

210 Steam Trap — Bulletin 257 describes a steam trap which uses the kinetic energy of steam to close the valve. Features of trap are detailed, and dimensional data included. Sarco Co., Inc.

PUMPS AND COMPRESSORS

211 Vertical Turbine Pump — Featured in 16-pp Bulletin 2400-B1 is a line of ultra high flow vertical turbine pumps. Design improvements, which result in broader coverage and higher efficiencies over wider operating ranges, are illustrated and described. Worthington Corp.

212 Chemical Feed Systems — Bulletin 558-3 describes a line of controlled volume pumps and accessories for feeding water treatment chemicals. Design and construction features are detailed, and specifications given. Milton Roy Co.

213 Air Compressors — Stationary air compressors for continuous, heavy duty service in industry are illustrated and described in Bulletin A-62. Contains specifications, diagrams, cross section drawings, and installation photos. Joy Mfg. Co.

PACKINGS, GASKETS

214 Mechanical Packings — Catalog P-210C contains 40 pp of detailed information on company's line of mechanical packings and gasket materials. It contains illustrations, descriptions, complete service recommendations and specification charts. Raybestos-Manhattan, Inc.

215 Gaskets and O-Rings — Gaskets, back-up rings and O-rings impervious to acids, alkalis, corrosives and solvents at temperatures from −120 to 500 F are described in 8-pp Bulletin P-327. Information includes service and mechanical recommendations, data on operating pressures and standard sizes. Crane Packing Co.

INSTRUMENTS, CONTROLS

217 Metering Control Systems — Bulletin 500 describes purpose, design and operation of company's metering and control systems. Includes discussion and pneumatic control, along with detailed literature references. Bailey Meter Co.

218 Data Logging System — Technical data on all functions of the Kybernetes Series 2000 Data System are presented in this 12-pp bulletin, including inputs, d-c amplification, analog-to-digital conversion, linearization, programming, integration, computer control and others. Specifications for all components and functions of the system included. Hagan Chemicals & Controls, Inc.

219 Instruments and Controls — Catalog 57-6 describes instruments and controls, including flow meters, liquid level

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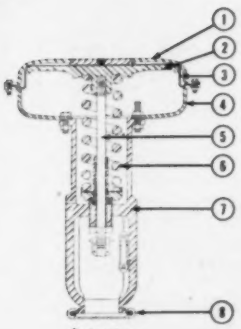
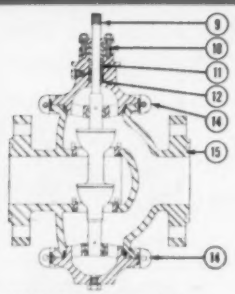
Make The BS&B *Super* 70

TODAY'S OUTSTANDING VALVE IN ITS CLASS!

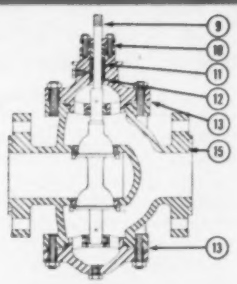
BS&B Super 70 Control Valves are widely used with instruments to control pressures, temperatures, liquid levels and flow. They efficiently handle gas, air, vapor, steam or liquids in a wide variety of applications. Valve bodies are available with either the patented clamp ring —float ring closures—up to 600# ASA— or the conventional flanged-gasketed type closures in ratings up to 2500# ASA.



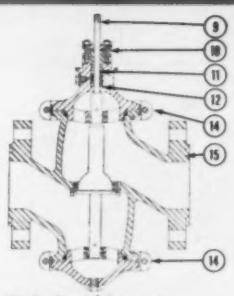
Actuator



DP Body w/clamp ring—float ring closure



DP Body w/flanged-gasketed closure



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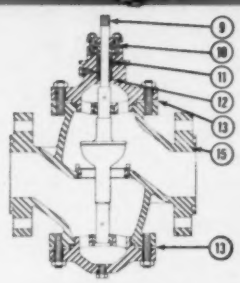

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1. Direct, Reverse and Pressure Balanced Actuator
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8. 2-Piece Forged Steel Clamp Ring
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11. Teflon CVU, TA and GA Packing
12. Solid Cast, Step-Type Design
13. Flanged-Gasketed Closure
14. Clamp Ring—Float Ring Closure
15. High Capacity, Stable Flow Body

SUPER TM BS&B 70

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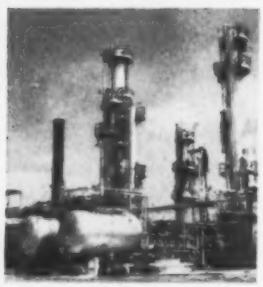
SARCO TOPICS

HOW TO SOLVE COMMON TRACER LINE PROBLEMS

How to cure water hammer with a steam trap that will operate in vertical position



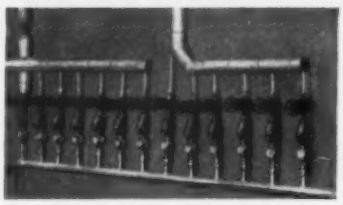
Water hammer is an inherent problem in long tracer lines. So is freezing. Both problems can be overcome, and here's an example of how it has been done. At the Socony Mobil Oil Company's Paulsboro, N. J., refinery, they found that the Sarco Thermo-Dynamic Steam Trap, type TD-50, not only withstands water hammer, but installing the trap in a vertical position —which permits free drainage—presents no problems at all, thanks to its unique thermodynamic principle. In fact, 90% of the 250 TD-50's at this plant are vertically mounted. They never block heat transfer, and they remove condensate and air as fast as they collect.

How to handle varied steam pressures — without adjustment

Can a trap — without adjustment — handle steam pressures that vary from 15 to 160 psi? Can the *same* trap vent air and drain condensate as rapidly as it is formed, be easy to install and require practically no maintenance at all? That was the problem set up by the engineering staff of Armour Chemical Division's McCook plant. They solved it by testing many traps. Their conclusion: Sarco TD-50 steam traps meet or beat their specifications, because:
they discharged condensate as fast as it formed, without wasting steam;
their compact inline construction made installation easy, even in tight quarters;
maintenance was practically negligible;
no adjustment was necessary for varying steam pressures. (In fact, the TD-50 is self-adjusting through its full operating range of 10-600 psi.)

No other steam trap can so adequately solve all these problems at one time.

How to be certain process fluid stays above 280° F. in tracer lines when outside temperature drops to—10° F.



The problem of maintaining design temperatures on tracer lines need not be difficult, no matter how extreme the conditions seem to be. For example, the tracer lines in a phthalic anhydride process at Witco Chemical Company's new Chicago plant had to be maintained above 280° F. Below this temperature, the chemical sets and the whole system would have to be taken apart and re-assembled. That's not all; ambient temperatures sometimes could drop to −10° F.

With reliability as a prime consideration, Scientific Design Company, Inc., who designed and constructed this brand new plant, selected the TD-50.

Because the TD-50 can be mounted vertically, freezing was no problem either. Added benefits that matter on tracer lines: the TD-50 is compact, light in weight, easy to install.

What is the most reliable tracer line trapping method to prevent unscheduled shutdown?

Particularly in refineries, steam traps have to function under exactly the kind of conditions that you'd expect to cause failure—they must function equally satisfactorily on low pressure or exhaust steam and on up through high-pressure, high temperature ranges. Not only that, but outside temperature may vary from subzero to subtropical. If maintaining design temperatures in your tracer lines appears to be hampered by these problems, consider how Phillips Petroleum Company, Kansas City, solved them. They found a trap which drains their tracer lines automatically over a full range of pressure, temperatures and loads. It's the Sarco TD-50 Steam Trap.

With only one moving part—a stainless steel disc, the TD-50 has little that can go wrong. In fact, it's so free of trouble that Phillips Petroleum Company consider their TD-50's as reliable and efficient as the piping. They now rely on 1800 of them throughout the plant. 1408

FOR FULL INFORMATION ON TRACER LINE TRAPPING or on any steam trapping problem—see your Sarco Sales Representative or write to

SARCO COMPANY, INC.
635 Madison Avenue,
New York 22, N. Y.
Plant: Bethlehem, Pa.

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES

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SARCO

Here are 7 Sound Reasons Why the Thermo-Dynamic® Does a Better Job of Trapping

1. *Simplicity*—has only one moving part. 2. *Maintenance*—practically zero. 3. *Wide pressure range*—one trap for all pressures from 10 to 600 psi. 4. *Uniform performance*—operates equally well on heavy, light, or no condensate load. 5. *Operates against back pressures*—up to 50% of inlet pressure. 6. *Rugged*—unaffected by superheat, water hammer, vibration, or corrosive condensate. 7. *Minimizes inventory* of spare parts.

Maintenance Time: 40 Seconds. If it now takes your maintenance crew more than a couple of minutes to service an ordinary trap, you're throwing away valuable time. This Sarco Thermo-Dynamic can be cleaned, blown out if necessary, and reassembled on the line in as little as 40 seconds.

For Prompt Information on the TD-50 . . . or for fast help on the efficient solution of any steam trapping problems, get in touch with a SARCO District Office, Sales Representative, or Distributor. (There's one near you.)

Only SARCO makes all 5 types:

Thermo-Dynamic* • Thermostatic • Liquid Expansion • Float Thermostatic • Inverted Bucket

*U.S. Pat. No. 2,817,353 TM Reg. U.S. Pat. Off. 1409

SARCO COMPANY, INC.
635 Madison Ave., New York 22, N. Y.

or pressure gage, CO_2 meters, boiler meters, pneumatic transmitters, strip chart recorder, pressure, vacuum and differential recorders, temperature recorder, multipoint gages and others. Includes descriptive data. Republic Flow Meters Co.

220 Controls Data — Comprehensive data on all types of controls, including diaphragm valves, pilot controllers, regulators, safety heads and tank vents are presented in this loose leaf notebook. Individual sections contain all pertinent information on each specific product, including descriptive details and engineering data, dimensions, specifications. Application and operation details are fully illustrated. Black, Sivalls & Bryson, Inc.

221 Draft Gages, Instruments — Bulletin 354-B is a condensed catalog giving a briefing on the company's line of stationary and portable draft gages, pitot tubes, air filter gages, gas analyzers, steam calorimeters. Ellison Draft Gage Co., Inc.

222 Water Columns, Gages — Featured in Bulletin 516B are boiler water columns and gage equipment. Illustrates and describes water columns for all pressures, as well as remote reading gages, liquid level alarms, water gage illumination equipment, and electrode-type liquid level alarms. Reliance Gauge Column Co.

223 Ion-Exchange Controls — Bulletin E-158 describes automatic control systems for ion-exchange equipment. Standards designed to assure proper performance of control units are detailed, and various elements in the control cabinets, as well as the power-operated units, are described. Specifications for electrical controls are also included. Illinois Water Treatment Co.

224 Laboratory Instruments — Illustrated and described in 12-pp Bulletin 757 is a line of pH meters and other electrochemical instruments. Also covers ultraviolet, visible, and near-infrared spectrophotometers, and describes typical applications. Scientific and Process Instruments Div., Beckman Instruments, Inc.

225 Ideas on Push-Pull Controls — Included in this "Idea File" are answers to a power engineer's questions on the use of push-pull controls. A general information booklet discusses remote control applications, explains construction and operation of company's Tru-Lay controls. Separate bulletins are devoted to standard assemblies, bracket-type head controls. Automotive and Research Div., American Chain & Cable Co., Inc.

226 Construction Services — Bulletin 107, 16-pp, describes and illustrates company's installation thru start-up service for automation and instrumentation systems. Services include a contract organization furnishing installation drawings, installation of panels, field instruments, field interconnections, commissioning, operator orientation and supplementary instrumentation personnel where needed. Panellit Service Corp.

BOILERS, GENERATORS

228 Package Boilers — This 12-pp booklet on package steam generators describes the formulas behind all package steam generators, and illustrates how installation of a package steam generator can raise steam capacity in an existing boiler room. Cyclotherm Div., National-U. S. Radiator Corp.

229 Hot Water Boilers — This 20-pp Brochure HCC-2 describes and illustrates design, construction, advantages and economics of the C-E La Mont controlled circulation hot water boiler for supplying high pressure, high temperature water for heating systems and process uses. Combustion Engineering, Inc.

230 Boilers for Many Services — This general product data catalog contains detailed literature on the company's line of boilers for heating, power and process steam. It contains separate data sheets for each product, including high pressure and low pressure boilers, boiler-burner units and water heating equipment. In addition to photos and diagrams illustrating design and operation features, it provides tabular engineering data. Industrial Div., American-Standard.

231 Steam Generators — Bulletin PSG-3 describes design and construction features of company's package unit steam generator, a vertical bent tube, longitudinally fired water tube boiler. Capacities, dimensions and weights are given. Henry Vogt Machine Co.

232 Packaged Steam Generator — Advantages of company's baffleless, pressurized two-drum water tube packaged units are detailed in 12-pp Catalog SB-59. Features of the completely integrated generating plant, which requires no field piping, wiring, brickwork or special foundation, are shown on cutaway illustration. Erie City Iron Works.

233 Packaged Generators — Booklet PG-58-2, on packaged steam generators, covers features, standard and optional equipment, capacities and dimensions. Foster Wheeler Corp.

234 Integral-Furnace Unit — Bulletin G-94 describes the Type PFI integral-furnace boiler, a pressurized-furnace oil- and gas-fired steam generator for power, process or heating loads requiring steam capacities to 400,000 lb-hr at pressures to 1150 psi and temperatures to 900 F. Includes information on membrane wall. The Babcock & Wilcox Co.

235 Package Boilers — Design and operation data on company's Type AS packaged water tube boilers for capacities from 4,000 to 21,000 lb per hr are detailed in this 10-pp product bulletin. Data and dimensions are tabulated and dimensional diagram included. Superior Combustion Industries, Inc.

COAL AND ASH HANDLING

236 Shredders, Crushers — Bulletin 257 describes and illustrates hammermills and shredders, rolling ring and special crushers for reducing chemicals, minerals, ceramics, and other materials including wood waste. Discusses construction features. American Pulverizer Co.

237 Coal Sample Crusher — How you can save on your fuel bill and power cost with company's coal sample crusher is explained in Bulletin CS2. Illustrated with photos and dimensional diagrams, discusses operation and features. Gruendler Crusher & Pulverizer Co.

238 Coal Crusher — Factors to consider in selecting a coal crusher for a particular operation are detailed in 12-pp Bulletin 154. Types of coal crushers and advantages of each are described and ca-

IT'S *what's behind* THE BALL THAT COUNTS!

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BEHIND BITUMINOUS is unlimited supply and ever increasing technology of utilization. *No other usable power source is backed by both these important characteristics.*

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pacity and specification data included. Gruendler Crusher & Pulverizer Co.

FUEL BURNING EQUIPMENT

239 Water-Cooled Stoker — Design and operating advantages of the Vibragrate Stoker are outlined in this illustrated bulletin. A large cutaway view details component parts of the stoker and explains operating features. Other drawings show installations. American Engineering Co.

240 Spreader Stoker — Advantages and features of company's continuous ash discharge spreader stoker are detailed in 24-pp Bulletin 40. Illustrates and describes operation details, and includes diagrammatically illustrated specifications, schematic diagrams showing installations with various types of boilers, and photos of typical installations. Detroit Stoker Co.

241 For Burning Refuse Fuel — This 8-pp bulletin describes refuse fuel burning equipment, including a pneumatic refuse fuel distributor which spreads refuse fuel such as bark, wood chips, and bagasse uniformly over the great surface. Discusses various components. Riley Stoker Corp.

242 Firing Units — Bulletin 28 describes steam atomizing packaged firing units for oil and/or gas fuels. Gives advantages of the units, specifications and general dimensions. National Airoil Burner Co., Inc.

243 Oil, Gas Burners — Bulletin G59 describes a combination gun-type gas and steam-atomizing oil burner unit. Features and advantages are detailed. The Engineer Co.

244 Pump and Heater Sets — Bulletin 15 describes packaged fuel oil pump and heater sets designed for accurate control of temperature and pressure of heavy oils to insure proper atomization and combustion. Features are described and engineering data presented. Walter H. Eagan Co., Inc.

VENTILATING AND AIR CONDITIONING

246 Ventilation Equipment — Package propeller fans for industrial and commercial ventilating applications are illustrated and described in 24-pp Bulletin FM-315. Features and advantages are detailed, and performance data rating tables and charts included to simplify selection. Buffalo Forge Co.

247 Liquid Absorbent Conditioner — Bulletin 140 describes a liquid absorbent air de-humidifier designed for drying, converting, processing, packaging and storage applications. Operation diagram is included, as well as graph showing water vapor equilibrium. Niagara Blower Co.

248 Air Conditioning Cabinets — Central station air conditioning cabinets are featured in 28-pp Bulletin AC-121. Cabinet and fan construction are detailed, and performance data included, as well as unit arrangement diagrams, physical data, weights, fan performance, dimensions, and coil ratings. Buffalo Forge Co.

ELECTRICAL EQUIPMENT

249 Synchronous Motors — Advantages of company's high speed synchronous motors are detailed in 12-pp Bulletin 501.

Cutaway view illustrates component parts and details of maintenance and operation. Applications and specifications data included. The Ideal Electric & Mfg. Co.

250 Handbook on Fuses — This 12-pp booklet contains practical information on how to get safe, dependable, trouble-free electrical protection. Shows what to do when fuses blow, how to determine cause of blows, what kind of fuse to use for various circuits. Contains short history of fuses and notes on construction of fuses. Bussmann Mfg. Co.

251 Tube Raceways — Described in 28-pp Catalog 5912 are two systems of support for all types of cables, wiring and tubing. Design and construction features are detailed, and load charts and dimensional data and diagrams included. The Globe Co.

252 Cable Troughs — This 28-pp catalog offers a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings, horizontal elbows, inside and outside vertical elbows, ties, crosses, covers and special devices. The Globe Co.

253 Terminal Boxes — Bulletin 28 describes a line of weatherproof multi-junction terminal boxes with cellular neoprene gasketed covers. Lists dimensions and capacities, and includes specifications and engineering drawings showing arrangement of terminal strips. Thermo Electric Co., Inc.

TUBING AND ACCESSORIES

254 Tubes and Plates — Publication B-2, 46 pp, covers the subject of tubes and plates for condensers and heat exchangers. Field of application and particular problems encountered in each are described. Information on condenser tube alloys, plates for tube sheets and baffles, manufacturing methods, installation, operational factors affecting tube life, corrosion factors in condenser tube service is presented. The American Brass Co.

255 Instrument Tubing — Detailed information on various types of instrument tubing and accessories is presented in this 16-pp bulletin. Among tubing described is extruded polyethylene tubing, extruded nylon tubing, tubes of copper, aluminum, and/or steel with polyethylene sheath, tubing with vinyl sheath, bundled instrument tubing. Dekoron Products Div., Samuel Moore & Co.

256 Tube Cleaners — Bulletin G-515 describes company's line of air, steam and water driven tube cleaners and accessories. Photos of the various types of cleaners are included, along with descriptive details and specification data. Elliott Co., Roto Plant, Div., Carrier Corp.

WATER CONDITIONING

258 pH and Chlorine Control — The 14th, 1959 edition of company's handbook, "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrate, sulfate, hardness and other tests. Slide comparators and complete test kits are illustrated. In addition to standard pH determinations, methods are outlined for quantitative analyses of phosphate, calcium,

New fuel cut-out control by Reliance

Pipe one device for double protection

and add alarm for approaching low water level if desired...

Reliance Levalarm EA-100P

Using but one water chamber — one set of pipes to boiler — this new Reliance Fuel Cut-out and Alarm control gives you two efficient devices in one.

At one end (right hand above) a positive float-operated switch cut-out; at the opposite end, an electrode-type control using U.L.-approved transformer-relay hook-up — completely independent of the float-type control but employs a common water chamber.

Check these possible use-combinations of the Levalarm EA-100P:

1. Dual fuel cut-out control.
2. Float-operated fuel cut-out and electrode-operated low water level alarm.
3. Electrode-operated fuel cut-out and float-operated low water alarm.
4. Float-operated fuel cut-out and electrode-operated fuel cut-out and electrode-operated low water alarm.

This Levalarm is the convenient answer in cases where two independent fuel cut-outs are required.

And this Levalarm provides outstanding additional safety to the operation of factory assembled boilers.

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Reliance BOILER SAFETY DEVICES

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to eliminate packing selection error

He is using Type #1 (Universal Plastic Packing). This packing meets the requirements of not just one pump, not just two pumps, but many kinds of pumps. R/M Type #1 Packing has the following characteristics: (1) low friction; (2) resistance to materials handled; (3) resistance to pressure; (4) resistance to heat.

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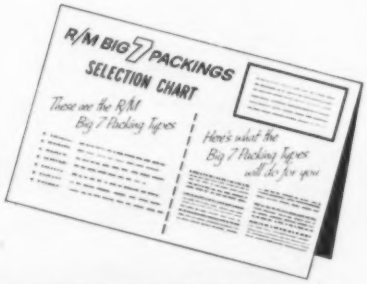

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PACKING DIVISION, PASSAIC, N. J.
MECHANICAL PACKINGS AND GASKET MATERIALS

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magnesium, silica, nitrate, hardness. Available to qualified power engineers, please state your job title. W. A. Taylor Co.

259 Feedwater Heaters — Open-Coil, tray-type feedwater heaters and purifiers of both deaerating and nondeaerating type are presented in 12-pp Bulletin 117-A. Construction and operational features of the heaters are explained and illustrated, and more than a dozen available models are pictured along with application suggestions. Stickle Steam Specialities Co.

260 Feedwater Treatment — Why boiler feedwater requires treatment and how this company solves feedwater problems by conditioning water for use to best advantage under prevailing conditions is explained in this folder. Discusses scale prevention, corrosion control, suppression of foaming and carry-over, and sludge dispersion. Western Chemical Co.

261 Cooling System Treatment — Bulletin C1 describes advantages of company's treatment for cooling tower systems with synergised polyphosphates. Details of the system are fully covered. Nalco Chemical Co.

262 Boiler Water Treatment — Chemical reduction of oxygen in boiler feedwater with hydrazine is the subject of 10-pp Bulletin BW. Economy and operation, handling of the Deoxy-Sol, methods of analysis and other details are covered. A bibliography lists supplementary reading. Fairmont Chemical Co., Inc.

263 Deaerating Heaters — Twelve pp Bulletin WC-106A on tray type deaerating heaters covers principles of deaeration, tray heater operation, standard heater design and applications, accessory equipment, and design and fabrication of tray utility heaters. A section on design features discusses load variations, installation, metallurgy and construction of trays. Graver Water Conditioning Co.

264 Condensate Corrosion Control — Advantages of company's film-type amine for controlling corrosion in steam condensate systems are detailed in Bulletin 410. Typical applications are described. Hagan Chemicals & Controls, Inc.

DUST CONTROL

265 Dust Control Unit — Featured in Bulletin V-100 is a conditioner unit for dust control, designed to apply rapid, on-the-spot conditioning to dust materials in all types of handling. Principles of operation are described in an accompanying engineering data bulletin, Bulletin V-101. The Johnson-March Corp.

266 Dust Collection and Recovery — A series of product bulletins on company's line of dust collecting, precipitation and gas scrubber equipment is available in this literature folder. Among the equipment described are electrical precipators, mechanical dust collectors, gas scrubbers, high temperature dust collector, reverse-jet equipment, rapper control, fly ash collector, transistomatic precipitator control, and related equipment. Western Precipitation Corp.

OTHER EQUIPMENT

267 Story of Coal — This pocket-size booklet presents a complete picture of company's operations, traces the history of the coal industry and describes the many

services and applications of coal. A colorful mural reproduced in the booklet pictures the part coal has played in civilization. Peabody Coal Co.

268 Pipe Insulation — Featured in brochure J-432 is a lightweight, flexible, one-piece pipe insulation composed of incombustible, moisture-resistant mineral wool fibers, bonded with a phenolic resin and molded into 6-ft long sections. Characteristics of the material are described. Baldwin-Ehret-Hill, Inc.

269 Cranes, Hydro Equipment — Twelve-pp Brochure HY-51 describes cranes and equipment for hydroelectric, water supply and other applications. Various components and assemblies that help harness hydroelectric power are pictured, including cranes and hoists, gates and valves, and special hydroelectric equipment. Yuba Consolidated Industries, Inc.

270 On Model Studies — Advantages of model studies for precipitators and other gas handling systems are presented in this 18-pp brochure. Discusses three plans under which this new engineering service is available. Several case histories are detailed to show benefits obtained. Also provided are articles on the subject reprinted from POWER ENGINEERING and other publications. Research-Cottrell, Inc.

271 Struts, Snubbers — Eight-pp Catalog 229A describes and illustrates ball-type flexible struts for structural applications and Vibrasnub hydraulic vibration snubbers. For each product line, catalog explains operation, provides specifications and illustrates engineering applications. Also discusses advantages of the flexible struts and includes design and installation notes. Barco Mfg. Co.

272 Forged Steel Couplings — Self aligning forged steel couplings designed to transmit maximum torque are described in illustrated Bulletin 450-M67. A cutaway view shows component features, and tables give ratings, sizes. Koppers Co., Inc.

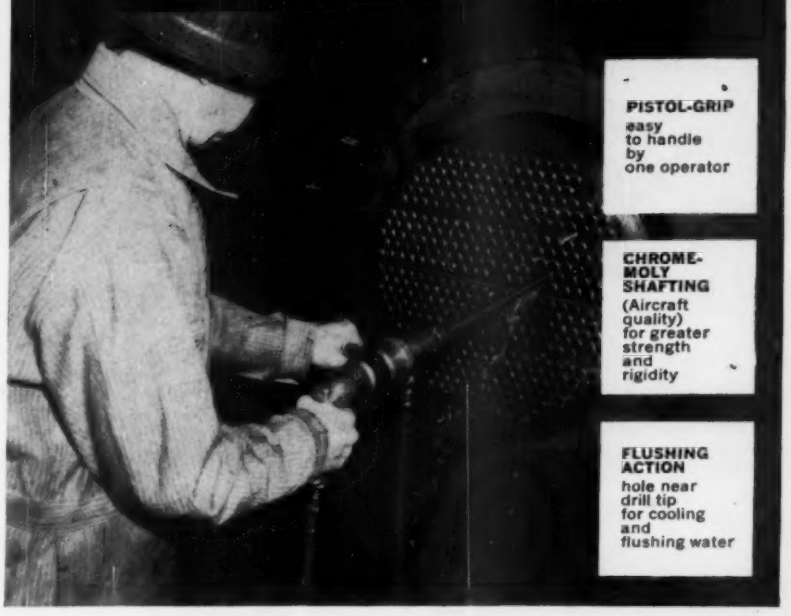
273 Steam Plant Data — Guide Specification GS-2 contains 78 pp of detailed information on ram-type underfeed stoker fired steam plants for steam loads of 10,000 to 40,000 lb per hour. Specifications provide full design criteria and suggestions for selection of equipment, including boilers, stokers, forced draft and overfire air systems, coal-handling equipment, ash-handling, combustion controls and instruments. Bituminous Coal Institute.

Bulletins reviewed here are offered primarily for qualified power engineers. Manufacturers may withhold literature from persons who do not state their job title and company. Some manufacturers also prefer not to send literature to those in foreign countries in which they have no sales representatives.

274 Organized Lubrication — This 12-pp bulletin discusses lubrication as a major cost control factor and how an organized lubrication system can affect overall operation costs. Responsibilities of various personnel, record-keeping, selection of lubricants, storage and application, identification of lubrication points, and other details covered. Texaco, Inc.

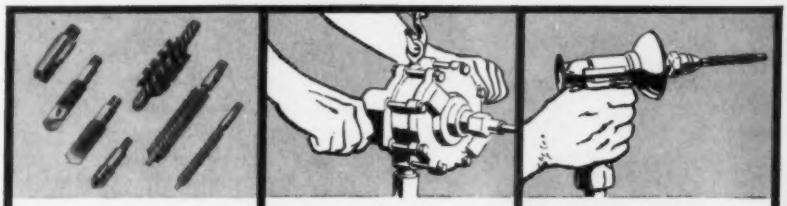
newest ELLIOTT tube cleaner

lightweight! air-driven!


PISTOL-GRIP
easy to handle by one operator
CHROME-MOLY SHAFTING
(Aircraft quality) for greater strength and rigidity
FLUSHING ACTION
hole near drill tip for cooling and flushing water

for condenser and heat exchanger tubes

Lightweight. Powerful. Air-driven. Trigger-action control with speed governor to prevent shaft-whip. High-speed motor reduced through planetary gears to 1500 rpm. Integral water-feeding attachment with finger-action valve which controls flow of cooling water into hollow shaft and drill or brush. Built-in oil reservoir. Send for tube cleaner bulletin Y-48.



DRILLS AND BRUSHES FOR VARIED NEEDS
Brushes for light deposits. Four types of drills clean light, hard-heavy, hard-light, and gummy deposits.

SUSPENSION TYPE
Air, steam or electric heavy-duty motor, for removing hard, heavy deposits. Ball bearings absorb thrust in either direction.

ELLIOTT JIFFY GUN
For extra-fast cleaning of light deposits in tubes ½ in. to 1¼ in. Air or water pressure shoots nylon brushes or rubber plugs through tubes.

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V9-1

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When You Figure Costs, The Best Results Come From American Coal Crushers

An independent survey of the performance of American Coal Crushers in 29 Mines and Power Plants showed these results:

Total Tonnage — 61,000,000

Average Age of Crusher — 9.5 years

Average Cost of Replacement Parts per Ton of Coal Crushed — $0.0012

There can be no better proof of the built-in quality of American Rolling Ring Coal Crushers.

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CHECK VALVES

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275 For Process Industries — Featured in 12-pp Bulletin G-3C is a line of equipment for the process industries, including pneumatic conveyors, compressors and vacuum pumps, coolers and preheaters, blowers, gas and vacuum pumps, fans and exhausters, and accessory equipment. Ratings tables and other data given. Fuller Co.

276 Sheet Metal Fabrication — Illustrated and described in 38-pp Bulletin F4 is plant and equipment used in the production of a variety of special sheet steel and alloy parts and sub-assemblies. Describes power plant fabrications, electrical enclosures, machines bases, guards, cabinets and boxes, stampings, concrete forms, transportation equipment parts, tanks, etc. The Kirk & Blum Mfg. Co.

277 Refrigerated Purging — Helpful data on purging refrigeration systems is presented in 12-pp Bulletin 700. Covers basic principles of automatic purging, selection, installation and operation of purgers, and specifications. Armstrong Machine Works.

278 Gas Turbine Engines — Featured in this 24-pp bulletin are engine data, performance curves and applications for company's gas turbine engines. Explains operation of gas turbines and includes photos showing applications, as well as engineering diagrams. Solar Aircraft Co.

280 Corrosion Control Tips — Control of water problems in air conditioning system — scale formation and slime and algae growths — is discussed in Bulletin 596. Offers suggestions for the control of these problems through adequate, planned chemical treatment. Application information as well as control testing data are included. Betz Laboratories, Inc.

281 Pneumatic Tools — Featured in Bulletin 67 is a line of pneumatic production equipment, including grinders, sanders, drills, reamers, screwdrivers, nutrunners, filing tools, and cutting tools. Descriptive details and specifications are included. Airetool Mfg. Co.

282 Steam Turbines — The advantages of company's solid wheel turbines, axial flow turbines, single stage and multistage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos. The Terry Steam Turbine Co.

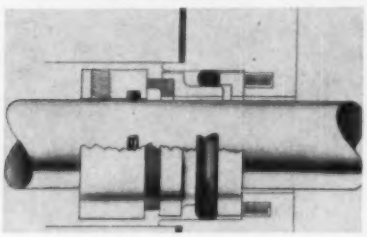
283 For Chemical Cleaning — Technical Bulletin 102, about 16 pp, presents application and other information on company's products for chemical cleaning. These include formulas for power plant cleaning, stainless-steel cleaning, aluminum and aluminum alloy cleaning, alkaline derusting and paint stripping, general cleaning, others. Also provided is chart of corrosion rates. Chas. Pfizer & Co., Inc.

284 For Desuperheating — Bulletin 1056 describes a carburetor-type desuperheater capable of being controlled to supply steam at a temperature within ± 5 F of plant requirements. Explains method of control and gives range of control attainable. Also describes structural details, system arrangements of components, and mechanical specifications. Copes-Vulcan Div., Blaw-Knox Co.

continued from page 106

26—SEAL operates on balanced fluid pressure alone

CounterPoise Seals are described as a simple, reliable means of providing positive and durable sealing by using balanced fluid pressure to replace operational springs. CounterPoise springs are

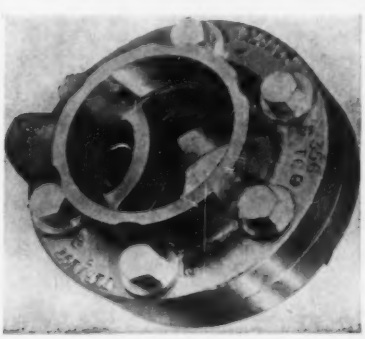


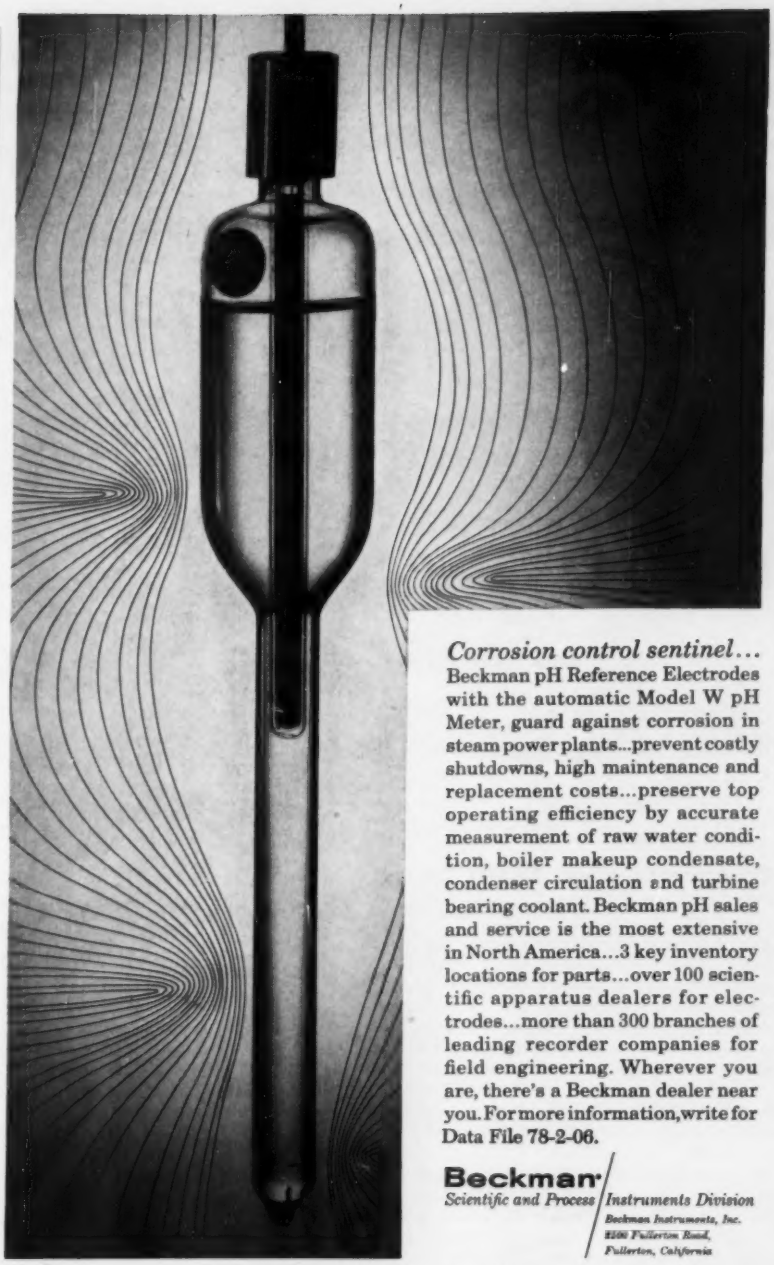
employed only to keep the deep carbon faces in contact when pump shutdown or pressure is reduced below operational level. In these seals, the use of hydraulic pressure eliminates the need for spring closing, it is explained, and excessive and uneven face wear eliminated. The seal is designed for easy installation by plant personnel, and one standard design is used for all pressures. A. W. Chesterton Co.

Reader Service Cards on pages 109–110 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

27—COMPACT COUPLINGS join aluminum steam traced piping

In 10 sizes to accommodate extruded aluminum steam-traced piping, Alcast Perfect Couplings simplify handling of chemicals and other products which must be heated while in transit through piping. Featuring easy assembly, the couplings come in three functional designs: Model 100 is bottom-tapped for intermediate condensate drainage; Model 100-SE is drilled and tapped for steam inlet and condensate drainage; and Model 100-B has steam section blank to provide for connection with untraced





Corrosion control sentinel...
Beckman pH Reference Electrodes with the automatic Model W pH Meter, guard against corrosion in steam power plants...prevent costly shutdowns, high maintenance and replacement costs...preserve top operating efficiency by accurate measurement of raw water condition, boiler makeup condensate, condenser circulation and turbine bearing coolant. Beckman pH sales and service is the most extensive in North America...3 key inventory locations for parts...over 100 scientific apparatus dealers for electrodes...more than 300 branches of leading recorder companies for field engineering. Wherever you are, there's a Beckman dealer near you. For more information, write for Data File 78-2-06.

Beckman
Scientific and Process Instruments Division
Beckman Instruments, Inc.
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The easiest — and quickest — way to order bulletins and catalogs described in this magazine is to use the postage-free Reader Service Cards on pages 109–110.

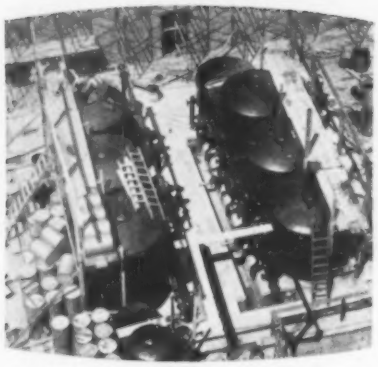
All you need to do is circle the item numbers of those you want. Then fill in your name, job title, company name and address — and mail the card.

You may also use the Reader Service Cards to request information on products described, or literature mentioned in the ads — just circle the number below the ad.

PATHWAYS OF A PIONEER

ILLCO-WAY DESIGNERS AND BUILDERS

MODERN EQUIPMENT FOR ionXchange



This picture was taken in *1943* of a Continuous *600 gpm* IonXchanger during installation at a midwestern chemical plant. The tanks are shown being loaded with ionXchange resins.

Blazing the Trail for De-I Developments

When the photograph above was made, IWT already had well over 50 large industrial ionXchangers in successful operation — yet ion-exchange in those days was still considered a "new and untried" process! Many of these pioneering IWT installations are *in use today*, and most of the early users of IWT ionXchange have *added to* and *modernized* their equipment as new developments became available.

Even today IWT is still pioneering — adding to its great stock of knowledge in this specialized field, designing and building up-to-date ionXchangers of all types and sizes for application to a wide variety of processes as well as all kinds of water-treatment, experimenting with and carefully testing new ionXchange uses, and constantly improving existing designs.

THIS EXPERIENCE CAN MEAN A LOT TO YOU

If you need pure water for high-pressure boiler make-up or process use, or if you are considering the use of ion-exchange for purification or concentration of chemical products, be sure to take advantage of IWT pioneering experience and specialized knowledge. *Call your IWT representative.*

ILLINOIS WATER TREATMENT CO.
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NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
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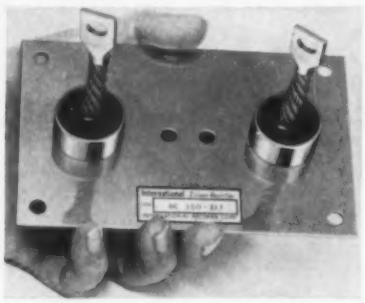
pipeline, pumps, tanks, valves. Designed to a tight bolt circle, to save space and weight, this is claimed the most compact coupling of its kind. Alcast Fittings.

28—SILICON RECTIFIER, 100 amp, for battery charging

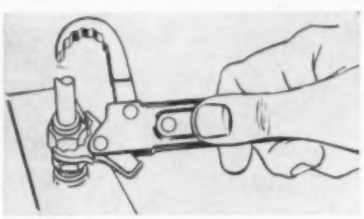
This low cost, 100-amp rated silicon rectifier, complete with heat sink, is designed for rapid, easy installation on a wide variety of battery charging applications. The center-tap rectifier features single unit, compact construction, con-



sisting of two silicon junctions mounted on a 4-by-6 in. nickel-plated copper cooling fin. Mounting holes are spaced to fit practically any charger. Junctions incorporate company's "Quad-Seal" process, including successive layers of humidity resistant, insulating resins and sealants assuring optimum operation over a temperature range from —20 to 130 C. Detailed data in Bulletin SR-210. International Rectifier Corp.

29—RATCHET WRENCH speeds fitting assembly

Of heavy duty construction, the cadmium plated steel Kwik-Tite Rachet Wrench is claimed ideal for work in close quarters. It is suggested for making up tube fittings, pipe fittings and hydraulic hose fittings, and for fastening machine nuts and hex fasteners. To use this tool, you place the jaws over the side of the



nut and lift the handle slightly. The wrench will snap close and ratchet. Once the wrench is in position, the harder you pull the tighter the jaws close, according to manufacturer, and to remove it, you apply light pressure, moving the handle forward and down, and this causes the jaws to snap open. The Imperial Brass Mfg. Co.

30—PRESSURE INDICATOR also transmits to remote recorder

Model 231 Indicating Transmitter, for low-to-medium pressures, can be located to provide pressure indicating at the point of measurement (or within 300 ft) on an easy-to-read dial. In addition,

THE LONERGAN LINE

A. J. Schmidt
Chief Engineer

SIZING SAFETY VALVES
by A. J. Schmidt, Chief Engineer

Selection of a safety or relief valve should be made on the basis of the capacity requirements of the application, rather than on pipe size alone. Using pipe size as the sole basis may result in a valve with far greater capacity than required and the valve may chatter on the installation due to a "starved" condition. On the other hand, pipe size selection may provide a valve with too little capacity, which will not give adequate over-pressure protection.

It is much better to select a safety or relief valve for the actual capacity requirements of the system. This will reduce the initial cost and will keep operating costs down because proper operation and protection will be obtained.

Lonergan safety and relief valves provide additional cost advantages due to the high capacities provided for any given pipe size. Thus, you can specify the smallest possible valve to meet your capacity requirements. Lonergan V, W, 11-W, and 41-W series safety valves also provide all the advantages of top guided, nozzle valve construction and two-ring positive control as embodied in Lonergan Patent No. 2414794.

Complete descriptions of Lonergan safety and relief valves for all applications are in catalogs 900-V and 1000-V. Write for your copy to the address shown below.

Alvin J. Schmidt

Lonergan

J. E. Lonergan Co., 207 Race Street, Philadelphia 6, Pa. Since 1872

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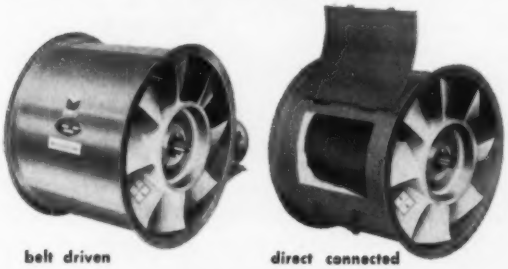
NEW 8 blade

tubeaxial fans

high speed - high efficiency

Aerovent's new Tubeaxial Fan, designed around a new 8-blade "Macheta" Airfoil Axial Flow Propeller, offers top performance against medium pressures at speeds to 3450 RPM. Available in 16", 18", 24", and 30" diameters, this unit combines speed, stamina and modern functional design. Easily installed in present ductwork or engineered to new construction, it's the right answer for resistances to 4" SP. Another outstanding development from Aerovent—America's finest industrial fans and air equipment.



belt driven direct connected

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Air deliveries of Aerovent equipment determined in accordance with established and accepted codes and guaranteed by manufacturer.

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FAN COMPANY, INC.

ASH and BRUSH STS. PIQUA, OHIO

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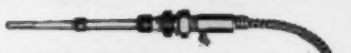
Improved Operation of literally hundreds of mechanical products has been effected with Acco Tru-Lay *flexible* PUSH-PULL Controls

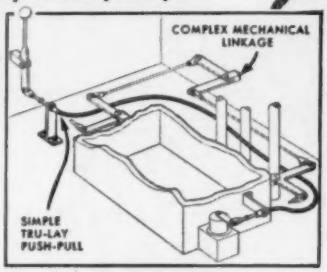


Tru-Lay Push-Pull Controls provide POSITIVE REMOTE-ACTION over long or short distances . . . with fixed or movable anchorages . . . for light loads or loads up to 1,000 lbs., and these units are frequently and successfully used in conjunction with Electric, Hydraulic and Air Controls.

Flexibility makes it possible to snake around obstructions . . . simplifies installation . . . reduces the number of working parts . . .

Simplicity vs Complexity

Compare the TRU-LAY PUSH-PULL cable in illustration with the mechanical linkage. PUSH-PULLS are simple, have but one moving part, are noiseless and give lifetime service accuracy. Linkages are complex, made of many parts; they wear at many points. Their use brings increased backlash, lost accuracy and vibration rattles.



Positive Remote-Action and Flexibility, together with Precision and Long Life, explain why TRU-LAY PUSH-PULLS serve designers and users equally well in improving machine operations, whether the application is on such severe service jobs as Bulldozers, Power Shovels and Steel Mill Machinery, or on such light duty work as Photographic Equipment, X-Ray or Business Machines.

Immunity to Vibration makes these TRU-LAY PUSH-PULLS ideal as Remote Controls on shakers and other vibratory products.

Complete Protection Against Dirt and Moisture is a big factor in the use of this unit on machinery in Coal Mines, Cement and Steel Mills, Oil Fields and in many other industries.

Corrosion-Resistance of the unit, plated or with Stainless Steel construction as required by the use, has led to many applications in the Marine Field . . . salt water or fresh. Supplied with a rubber cover the unit operates effectively even when conduit is COMPLETELY IMMERSED.

Lubrication of the inner working member is for life.

Temperatures as low as —70°F will not hinder the proper operation of this unit, and it is thoroughly effective even in the extreme high temperatures encountered on Jet Engine, Furnace Door and Glass Furnace Damper control applications.

Our **DATA FILE** *will answer your further questions. Write for a copy without obligation*

ACCO

Automotive and Aircraft Division
AMERICAN CHAIN & CABLE

TRADE MARK

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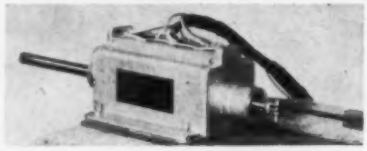
this unit can simultaneously transmit pressure measurement electrically to any of company's remote-located recorders or indicators. As pointed out by manufacturer, this combination provides flexibility of having pressure indication exactly at the point of measurement of the process — while being able to record and indicate that same measurement at a distant location.

Its application is measurement of pressure (or draft), differential pressure (flow) of air or non-corrosive gases, ranges from 0-0.2 in. to 0-120 in. water, and for static pressure to 65 psig. Field conversions can be made from pressure to suction or to differential service. Only piping connections are to the transmitter itself, the only wiring connections required consisting of three-wire transmission to the remote receiver. The Hays Corp.

31—CONTROL DEVICE responds to input with linear movement

This electrical device, the Linear Positioning Motor, responds to an input with instantaneous linear movement of its shaft to any of several positions. Exact amount of shaft movement is determined and selected by simple input devices such as switches, relays, pushbuttons, contacts, or by more complex digital inputs. As input is selected, the shaft of the motor moves to the proper position, uninterrupted by intermediate reference points, stops, ratches. Repeatability within 0.005 in., travel times of 100 milleseconds, and thrusts of 100 lb or more are claimed possible. The shaft of the motor is the only moving part, and it moves in a linear direction only, although the shaft is free to rotate with the attached load.

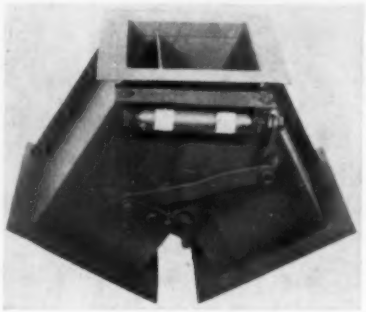
The shaft can be attached to a load requiring only simple positioning, such



as a slide switch, or to one requiring a linear positioning superimposed on an existing rotary. General applications include tuning, signalling, switching, positioning. Tronics Corp.

32—BIFURCATING GATES have one removable side

This line of bifurcating gates for diverting a stream of bulk material from one direction to another features one re-



REMOVE OXYGEN

FROM BOILER WATER...

DEOXY-SOL

Fairmount DEOXY-SOL, a solution of hydrazine, is a high efficiency oxygen scavenger designed especially for high pressure boiler water treatment.

DEOXY-SOL removes oxygen, reduces oxides and raises pH of the condensate all at the same time . . . yet adds no solids.

Stocks in Newark, N. J., Chicago, Ill., Los Angeles, Calif. Investigate its advantages for your system. Write for Bulletin BW.

Fairmount
CHEMICAL CO., INC.
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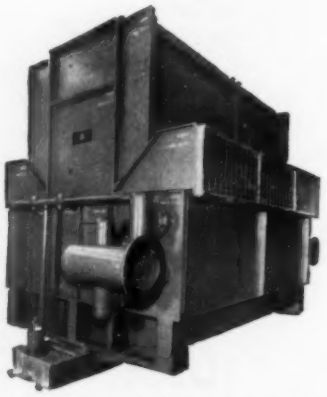
ECONOMICAL COOLING OF GASES AND COMPRESSED AIR



Cooling gases or cooling and removing moisture from compressed air, the Niagara *Aero* After Cooler offers the most economical and trustworthy method. Cooling by evaporation in a closed system, it brings the gas or compressed air to a point below the ambient temperature, effectively preventing further condensation of moisture in the air lines. It is a self-contained system, independent of any large cooling water supply, solving the problems of water supply and disposal.

Cooling-water savings and power-cost savings in operation return your equipment costs in less than two years. New sectional design reduces the first cost, saves you much money in freight, installation labor and upkeep. Niagara *Aero* After Cooler systems have proven most successful in large plant power and process installations and in air and gas liquefaction applications.

Write for Descriptive Bulletin 130.

NIAGARA BLOWER COMPANY
Dept. E-2, 405 Lexington Ave., New York 17, N. Y.
Niagara District Engineers in Principal Cities of U. S. and Canada

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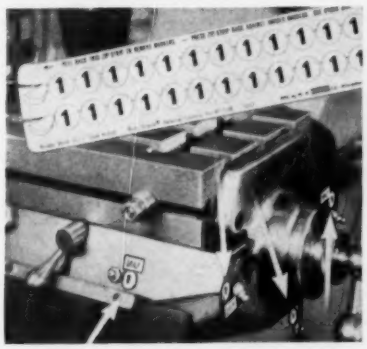
movable side for easy cleaning. Movement of the gate is by tilt bar for hand operation or by air cylinder. Standard size range is from 6 to 16 in., in stainless galvanized or carbon steel. The flop gate shaft rides in self-aligning bronze bearings which can be mounted outboard with inboard mechanical seals or stuffing boxes. The Bucket Elevator Co.

33—SUBMASTER CONTROL for heating, air conditioning

Series 200 Submaster Regulator is introduced for control of remotely readjusted temperatures in heating, air conditioning, and industrial processes. It is pneumatically operated temperature controller, whose control point is reset by a master controller or positioning switch. The master may be a thermostat, hygrostat, pressure regulator, or manual positioning switch, and has a throttling range adjustment of 0 to 35 percent. The gas-filled thermal system is claimed unaffected by cross ambient bulb and capillary temperatures and to eliminate need for bulb elevation correction. It is provided with direct action and reverse adjustment, both convertible. Additional information is in Form P-73. The Powers Regulator Co.

34—VINYL MARKERS provide standardized lubrication system

An economical method to assure regular and correct lubrication of machinery and equipment utilizes self-sticking Lube Labels to identify lubrication points, tell the types of lubricant to use, and indicate frequency of lubrication. The plan can be adopted by itself, or worked into existing systems. The labels, on handy dispenser cards, are ready for application adjacent to lubrication points. You simply wipe the surface with a chlorinated cleaning solution and apply.



Manufacturer says these vinyl labels may be used on flat or curved surfaces; they resist oil, grease and abrasion. They are stocked in five bright colors, which give 50 codes to identify different greases, oils and fluids. Other labels, to indicate lubrication frequency and mark lube dispensers and containers, are also available from stock. W. H. Brady Co.

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Position open for Mechanical Sales Engineer

for Boiler Sales and Engineering—College Graduate, under 35, Military Training completed. Location New York City Trading Area. Previous experience desirable but not a must. Salary dependent on applicant's qualifications. Send complete resume of education and experience to Box 1733. **Power Engineering,** 308 E. James Street, Barrington, Illinois.

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Long-established manufacturer of steam and machinery specialties has open for Mechanical Engineer, preferably with experience in the use of steam for process and heating, as related to the manufacture and application of steam traps, control valves and similar products. To assist Chief Engineer in design, application and sales engineering. Location Eastern Pa. Send resume of qualifications, experience, when available and salary requirements to Box 1735. **Power Engineering,** 308 E. James Street, Barrington, Illinois.

PROJECT ENGINEERS

Established Philadelphia engineering and construction firm has permanent staff positions open for graduate mechanical engineers with 5 years minimum experience as Project Engineers in design of steam electric power stations involving project interoffice and client coordination. Salary will be commensurate with experience and ability. Excellent working conditions and liberal company benefits.

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Large engineering and construction firm engaged in central station, industrial, and chemical work has permanent staff position open for graduate mechanical engineer familiar with specifications and report writing. While many years of experience are highly desirabe, your merit will be given full consideration.

Salary commensurate with experience and ability. Excellent working conditions and liberal company benefits.

Applicants please submit full details including personal data, education, experience and salary desired in your reply. Write Box 1736. **Power Engineering,** 308 E. James Street, Barrington, Illinois.

save on installation and maintenance

with

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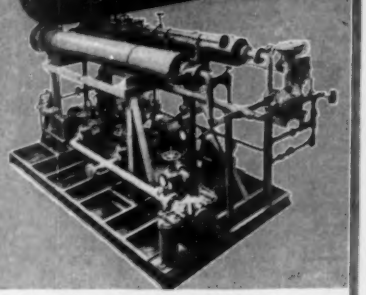
"pre-packaged"

FUEL OIL PUMP and HEATER SETS



Use an Eagan "pre-packaged" fuel oil pump and heater set for the preparation of heavy oil for combustion. You save time and money because units are completely assembled, ready for immediate installation. Only connections to oil and steam supply, burner, by-pass and relief lines have to be made and you avoid the combustion difficulties so often caused by field assembled combinations.

Here are additional benefits Eagan gives you:

- **Generous reserve capacity, at least 50% over peak burner demand, allows for eventual wear and future demand increases.**
- **Maintenance is easy and at a minimum. Parts requiring service are easily accessible.**
- **"Honest", solid construction, excellent engineering assure long life, trouble-free operation.**
- **Compact units save space.**

EAGAN fuel oil pump and heater sets heat to 300° F, pump to 400 psi and have capacities to 3000 gph. Single or duplex units are available for steam or electric drive. Duplex "electro-steam" sets provide for electrical failure by incorporating one steam pump and one electric motor driven pump. Other EAGAN sets can be made to your special requirements.

Write, wire or call for further information or let us bid on your job.

WALTER H. EAGAN CO., INC.

2337 Wallace Street, Phila. 30, Penna.

STevenson 7-2300

Mfrs. of condensate, boiler feed, turbine, centrifugal and proportioning pumps and fuel oil pump and heater sets.

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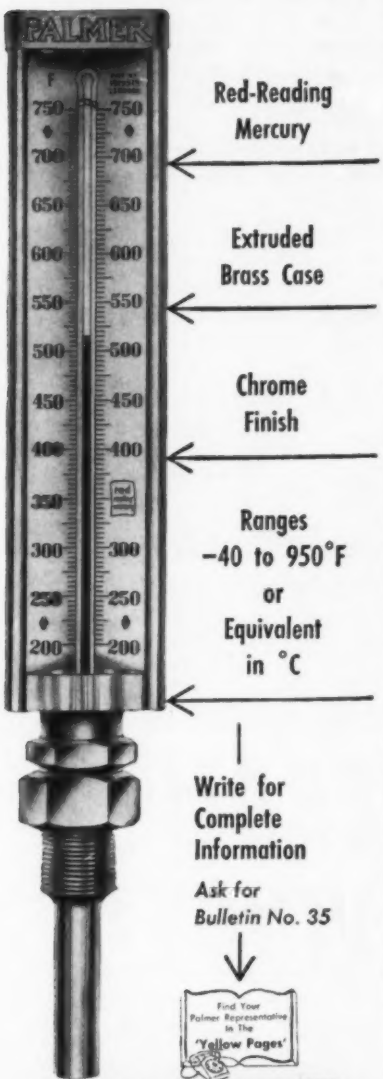
Demands a Modern Thermometer

PALMER

RED-READING MERCURY THERMOMETERS



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Mfrs. of Industrial Laboratory, Recording and Dial Thermometers

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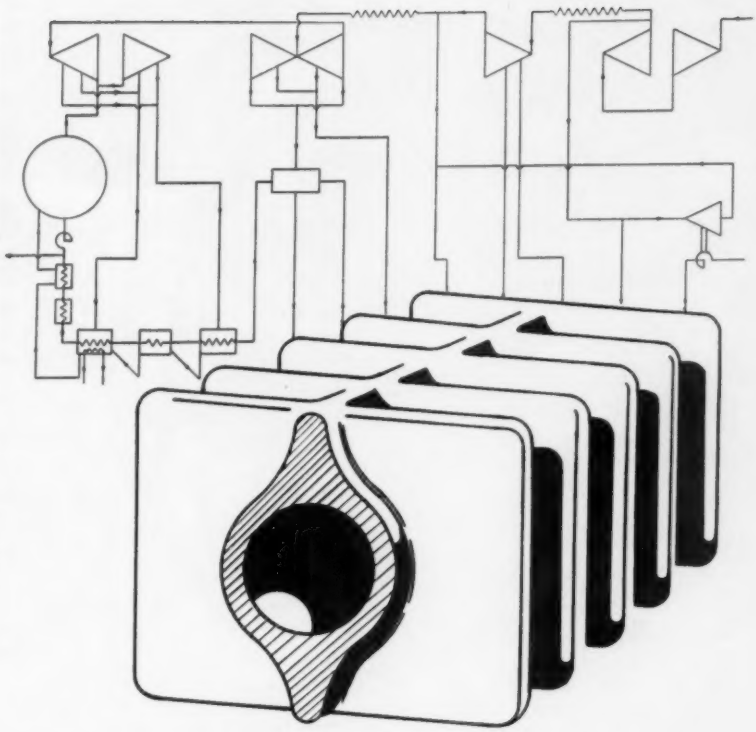

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Why has Green's Low-Level Economizer already been purchased for inclusion in several large units scheduled for operation in 1960, 1961 and 1962?

1. It is accepted that low-level heat recovery offers the most economic method of obtaining the lower heat rates required today.

2. Flue gas-to-water heat exchange transfers the low temperatures from the airheater to the Low-Level Economizer where the problems of corrosion and plugging can be adequately resolved.

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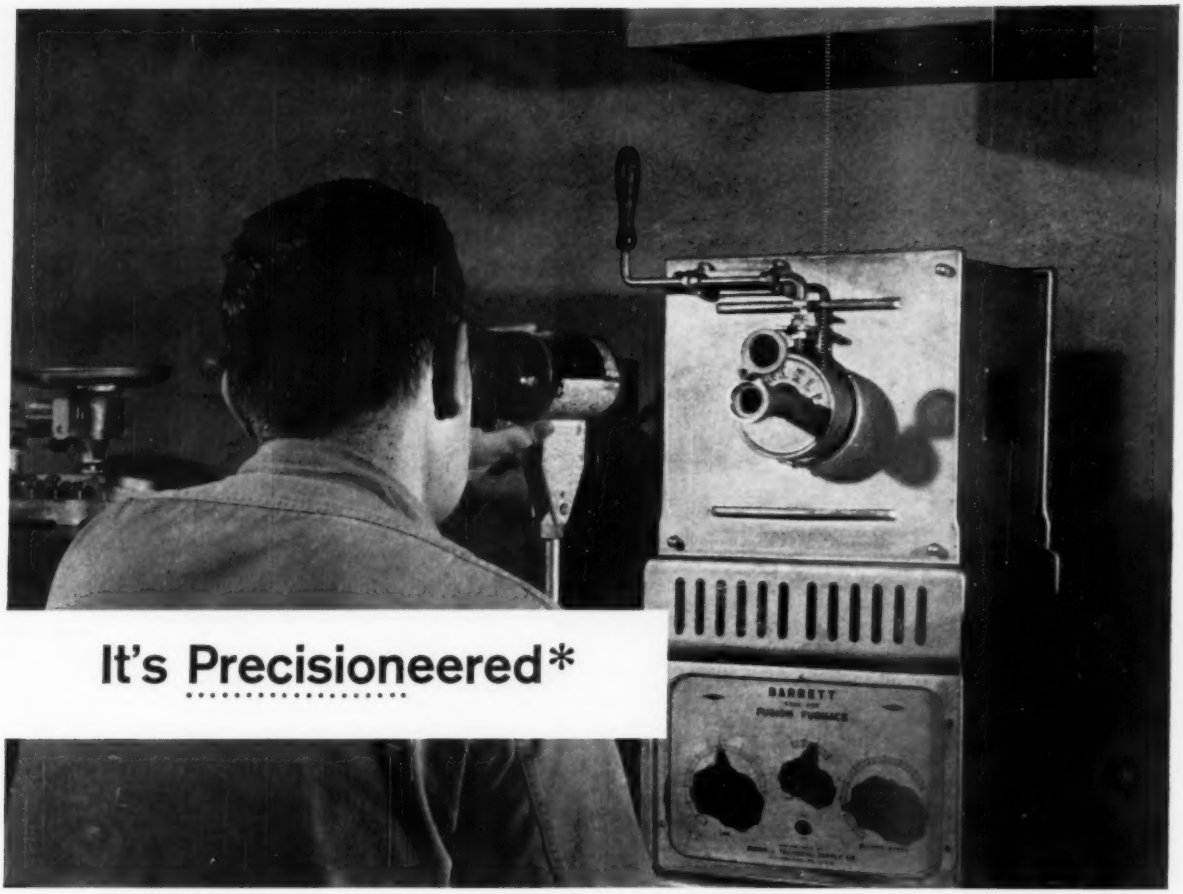
Why does Island Creek coal so often lower the cost per 1000 pounds of steam?...



It's Precisioneered*

An Island Creek technician uses the optical pyrometer to determine ash fusion point of a coal

* PRECISIONEERING at Island Creek is many things. Essentially, it is starting with superior seams of eastern coal . . . and preparing it to the exact specifications your burning equipment requires to produce steam at the lowest net cost per 1000 lbs. This involves the use of precision engineering techniques in the most modern preparation plants. It involves strictest laboratory controls. It involves far-reaching engineering service and evaluation studies. From start to finish it involves the career company attitude that has made Island Creek a leader to whom other leaders may look—with confidence. We'd welcome a chance to get down to net costs—with you and your plant people. Write. Or phone. No obligation, of course.

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Precisioneered Coal

You can depend on Island Creek . . . a career company dedicated to coal

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you'll want them in your new specifications

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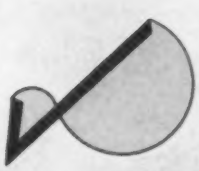
Thermasil now offers more advantages than ever before. Take the matter of strength! The hardness of a calcium silicate should be sufficient to permit safe and easy handling, resist damage from vibration and accidental concussion—yet not be too hard, because low application costs depend on being able to use conventional tools. Only Thermasil has this ideal combination of strength and toughness. And there are other advantages in durability, "hinge strength," freedom from shrinking, warping and cracking.

Continuing product improvement by Baldwin-Ehret-Hill makes it essential to keep your ideas fresh - with timely, accurate knowledge of constantly changing insulation materials. You'll realize that old specifications are of little value in writing new ones for modern installations. Baldwin-Ehret-Hill offers you the complete line—a selection of over thirty specialized insulations for service from sub-zero to 1900 F. To bring your specifications up to date, write for our 1960 catalog or see it in your Sweet's Files.



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